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The most serious health risk confronting individuals exposed to radiation is death from an induced cancer. Since cancers usually do no develop until many years after exposure, other causes of death may intervene and take the lives of those destined to die from cancer. This computer code has been developed to aid risk analysis by calculating the number of premature deaths and loss of years of life produced by a hypothetical population after exposure to a given risk situation. The code generates modified life tables and estimates the impact of increased risk through several numerical comparisons with the appropriate reference life tables. One of the code's frequent applications is in estimating the number of radiation induced deaths that would result from exposing an initial population of 100,000 individuals to an annual radiation dose. For each risk situation analyzed, the computer code generates a summary table which documents the input data and contains the results of the comparisons with reference life tables.

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A COMPUTER CODE FOR COHORT ANALYSIS OF INCREASED RISKS OF DEATH (CAIRD)

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June 1978

U.S. Environmental Protection Agency
Office of Radiation Programs
Criteria & Standards Division

FOREWORD

The Office of Radiation Programs carries out a national program to evaluate the exposure of man to ionizing and nonionizing radiation and to develop guidance, standards, and criteria for the protection of public health the quality of the environment.

This report describes a more refined methodology than heretofore used for assessing the potential health impact of exposure to low levels of ionizing radiation, as well as providing a means for comparing these risks to those from other sources.

Readers are encouraged to bring to our attention any difficulties encountered in their use of this code, as well as comments or suggestions for its improvement. These comments should be directed to John R. Cook, Federal Guidance Branch, Criteria and Standards Division (AW-460), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460.

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1. INTRODUCTION

An important consideration in the development of radiation protection guidance and standards is the analysis of the health risk incurred by the individuals in an exposed population. The most serious somatic risk confronting individuals exposed to radiation is death from an induced cancer. These cancers, in general, do not develop until many years after exposure. The delay permits other causes of death to intervene and take the lives of those otherwise destined to die from cancer. Thus two considerations must be accounted for in radiation risk analysis: the temporal distribution of induced cancers and competing risks of death.

A computer code, CAIRD (Cohort Analysis of Increased Risks of Death), has been developed to aid risk analysis by calculating the number of premature deaths and loss of years of life produced in a hypothetical population after exposure to a given risk situation. The number of premature deaths is estimated using life tables. A life table methodology has been used recently to determine the risk/benefit ratio of mammography.[1] Although the CAIRD code can be used with any set of age specific probabilities of death, the 1969-71 U.S. population data, as reported by the National Center for Health Statistics (NCHS) in its decennial life tables, have been used in the CAIRD calculations performed to date.[2]

The NCHS life tables contain age specific probabilities of death from all causes for various population groups, as well as associated survival and longevity information. They are useful for risk analysis because they provide a baseline or reference for the risk of death from all causes for any given age. The effect of an increased risk may be calculated by incorporating the corresponding increase in the probabilities of death into generated life tables and comparing the results with reference life tables.

The CAIRD code generates modified life tables and estimates the impact of the increased risk through several numerical comparisons with the appropriate reference life tables. These comparisons yield: (1) the number of persons dying prematurely due to the increased risk of death; (2) the total number of years of life lost by those dying prematurely; (3) the average number of years of life lost for those dying prematurely; and (4) the decrease in the population's life expectancy at birth.

One of CAIRD's frequent applications is in estimating the number of radiation induced cancer deaths that would result from exposing an initial population of 100,000 individuals (cohort) to an annual radiation dose. Either the absolute or relative risk models, as developed by the National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation (BEIR report), may be used to estimate the risk of radiation induced cancer death.[3] The effects of an incremental accident risk on the cohort may also be calculated, either separately or in combination with radiation risk. The code may be used for risk analyses involving the male, female or total population, the latter being a combination with the same sex ratio as that of the U.S. population.

For each risk situation analyzed, the CAIRD code generates a summary table which documents the input data and contains the results of the comparisons with the reference life tables. In addition to the summary table, the generated life table, as well as two tables which contain the age distribution of deaths due to radiation risks, may be produced.

2. NCHS LIFE TABLES

2.1 Definition of Standard Life Table Terms

A life table for the total population, prepared by the National Center for Health Statistics, is reproduced in Table I. The example shows the overall mortality experience for the U.S. population during 1969-1971, regardless of sex, race, national origin, etc. A brief description of columns in the table follows:

1) Age interval (x to x+t) - period of life between the specified ages.

2) Proportion dying (${}_tq_x$) - proportion of the population alive at the beginning of the age interval who will die before reaching the end of the interval. This may also be considered the probability of death for each age interval.

3) Number surviving (l_x) - the number of persons, starting with a population of 100,000 live births, who will survive to the beginning of the specified age interval.

4) Number dying (${}_td_x$) - the number of persons dying in the age interval.

5) Average number years lived (${}_tL_x$) - the average number of person-years of life lived in the age interval, assuming deaths are uniformly distributed across the age interval.

6) Total years of life (T_x) - the number of person-years of life remaining to the persons surviving at the beginning of the age interval.

7) Average remaining lifetime ($\overset{o}{e}_x$) - the average number of years of life remaining to persons surviving at the beginning of the age interval.

2.2 Interpretation of Life Table Data

The life table data in Table I may be used to define either a single cohort or a stationary population model. The single cohort interpretation assumes that there is one cohort of 100,000 persons, all of whom are simultaneously liveborn. During the first year of life, the cohort is exposed to the probability of death for 0-1 years-olds as listed in column 2. The product of this probability and the cohort size (column 3) yields the number of persons in the cohort that die during the 0-1 age interval (column 4). These deaths are subtracted from the cohort size to generate the number of survivors that proceed to the succeeding age interval, which is entered in the third column for the following (1-2) age interval. The years of life lived in the interval (column 5) is equal to the average of the numbers surviving at the beginning and end of the age interval. Finally, the total number of years of life remaining to the survivors entering the age interval is

Table I

Life Table for the Total Population, U.S. 1969-71

AGE INTERVAL	PROPORTION DYING	OF 100,000 BORN ALIVE		STATIONARY POPULATION		AVERAGE REMAINING LIFETIME
PERIOD OF LIFE BETWEEN TWO AGES	PROPORTION OF PERSONS ALIVE AT BEGINNING OF AGE INTERVAL DYING DURING INTERVAL	NUMBER LIVING AT BEGINNING OF AGE INTERVAL	NUMBER DYING DURING AGE INTERVAL	IN THE AGE INTERVAL	IN THIS AND ALL SUBSEQUENT AGE INTERVALS	AVERAGE NUMBER OF YEARS OF LIFE REMAINING AT BEGINNING OF AGE INTERVAL
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+t$	$_tq_x$	l_x	$_td_x$	$_tL_x$	T_x	$\mathring{e}_x$
DAYS						
0-1	0.00874	100,000	874	272	7,074,927	70.75
1-7	.00482	99,126	478	1,626	7,074,655	71.37
7-28	.00147	98,648	145	5,671	7,073,029	71.70
28-365	.00513	98,503	535	90,714	7,067,358	71.75
YEARS						
0-1	.02002	100,000	2,002	98,283	7,074,927	70.75
1-2	.00125	97,998	122	97,937	6,976,644	71.19
2-3	.00086	97,876	84	97,834	6,878,707	70.28
3-4	.00069	97,792	68	97,758	6,780,873	69.34
4-5	.00057	97,724	56	97,696	6,683,115	68.39
5-6	.00051	97,668	49	97,643	6,585,419	67.43
6-7	.00046	97,619	46	97,596	6,487,776	66.46
7-8	.00043	97,573	42	97,553	6,390,180	65.49
8-9	.00039	97,531	37	97,512	6,292,627	64.52
9-10	.00034	97,494	34	97,477	6,195,115	63.54
10-11	.00031	97,460	30	97,445	6,097,638	62.57
11-12	.00030	97,430	29	97,415	6,000,193	61.58
12-13	.00035	97,401	34	97,384	5,902,778	60.60
13-14	.00046	97,367	45	97,344	5,805,394	59.62
14-15	.00063	97,322	61	97,292	5,708,050	58.65
15-16	.00082	97,261	80	97,221	5,610,758	57.69
16-17	.00101	97,181	98	97,132	5,513,537	56.73
17-18	.00117	97,083	113	97,027	5,416,405	55.79
18-19	.00128	96,970	124	96,908	5,319,378	54.86
19-20	.00134	96,846	130	96,781	5,222,470	53.93
20-21	.00140	96,716	136	96,648	5,125,689	53.00
21-22	.00147	96,580	142	96,510	5,029,041	52.07
22-23	.00152	96,438	146	96,365	4,932,531	51.15
23-24	.00153	96,292	147	96,218	4,836,166	50.22
24-25	.00151	96,145	145	96,072	4,739,948	49.30
25-26	.00147	96,000	141	95,929	4,643,876	48.37
26-27	.00143	95,859	138	95,790	4,547,947	47.44
27-28	.00142	95,721	135	95,654	4,452,157	46.51
28-29	.00144	95,586	138	95,517	4,356,503	45.58
29-30	.00149	95,448	141	95,377	4,260,986	44.64
30-31	.00155	95,307	149	95,233	4,165,609	43.71
31-32	.00163	95,158	155	95,080	4,070,376	42.77
32-33	.00172	95,003	163	94,922	3,975,296	41.84
33-34	.00183	94,840	174	94,753	3,880,374	40.92
34-35	.00195	94,666	184	94,574	3,785,621	39.99
35-36	.00209	94,482	197	94,384	3,691,047	39.07
36-37	.00225	94,285	212	94,179	3,596,663	38.15
37-38	.00244	94,073	230	93,958	3,502,484	37.23
36-39	.00266	93,843	250	93,718	3,408,526	36.32
39-40	.00290	93,593	271	93,457	3,314,808	35.42
40-41	.00314	93,322	294	93,175	3,221,351	34.52
41-42	.00341	93,028	316	92,870	3,128,176	33.63
42-43	.00370	92,712	344	92,540	3,035,306	32.74
43-44	.00404	92,368	373	92,182	2,942,766	31.86
44-45	.00443	91,995	408	91,791	2,850,584	30.99
45-46	.00484	91,587	443	91,365	2,758,793	30.12
46-47	.00528	91,144	482	90,903	2,667,428	29.27
47-48	.00574	90,662	520	90,402	2,576,525	28.42
48-49	.00624	90,142	563	89,861	2,486,123	27.58
49-50	.00678	89,579	607	89,275	2,396,262	26.75

Table I cont'd

Life Table for the Total Population, U.S. 1969-71

AGE INTERVAL	PROPORTION DYING	OF 100,000 BORN ALIVE		STATIONARY POPULATION		AVERAGE REMAINING LIFETIME
PERIOD OF LIFE BETWEEN TWO AGES (1)	PROPORTION OF PERSONS ALIVE AT BEGINNING OF AGE INTERVAL DYING DURING INTERVAL (2)	NUMBER LIVING AT BEGINNING OF AGE INTERVAL (3)	NUMBER DYING DURING AGE INTERVAL (4)	IN THE AGE INTERVAL (5)	IN THIS AND ALL SUBSEQUENT AGE INTERVALS (6)	AVERAGE NUMBER OF YEARS OF LIFE REMAINING AT BEGINNING OF AGE INTERVAL (7)
x to $x + t$	${}_tq_x$	l_x	${}_td_x$	${}_tL_x$	T_x	$\mathring{e}_x$
YEARS--CON.						
50-51	.00738	88,972	657	88,644	2,306,987	25.93
51-52	.00804	88,315	710	87,960	2,218,343	25.12
52-53	.00876	87,605	767	87,221	2,130,383	24.32
53-54	.00957	86,838	831	86,422	2,043,162	23.53
54-55	.01043	86,007	897	85,558	1,956,740	22.75
55-56	.01136	85,110	968	84,626	1,871,182	21.99
56-57	.01236	84,142	1,039	83,623	1,786,556	21.23
57-58	.01341	83,103	1,115	82,545	1,702,933	20.49
58-59	.01452	81,988	1,190	81,393	1,620,388	19.76
59-60	.01570	80,798	1,269	80,163	1,538,995	19.05
60-61	.01695	79,529	1,348	78,856	1,458,832	18.34
61-62	.01829	78,181	1,430	77,466	1,379,976	17.65
62-63	.01974	76,751	1,515	75,994	1,302,510	16.97
63-64	.02133	75,236	1,605	74,433	1,226,516	16.30
64-65	.02306	73,631	1,698	72,782	1,152,083	15.65
65-66	.02495	71,933	1,794	71,036	1,079,301	15.00
66-67	.02699	70,139	1,893	69,192	1,008,265	14.38
67-68	.02918	68,246	1,992	67,250	939,073	13.76
68-69	.03152	66,254	2,088	65,210	871,823	13.16
69-70	.03400	64,166	2,182	63,074	806,613	12.57
70-71	.03661	61,984	2,269	60,849	743,539	12.00
71-72	.03943	59,715	2,355	58,538	682,690	11.43
72-73	.04266	57,360	2,447	56,136	624,152	10.88
73-74	.04644	54,913	2,550	53,638	568,016	10.34
74-75	.05075	52,363	2,658	51,034	514,378	9.82
75-76	.05552	49,705	2,759	48,325	463,344	9.32
76-77	.06060	46,946	2,845	45,523	415,019	8.84
77-78	.06596	44,101	2,909	42,647	369,496	8.38
78-79	.07153	41,192	2,947	39,718	326,849	7.93
79-80	.07741	38,245	2,960	36,766	287,131	7.51
80-81	.08394	35,285	2,962	33,803	250,365	7.10
81-82	.09122	32,323	2,948	30,849	216,562	6.70
82-83	.09892	29,375	2,906	27,922	185,713	6.32
83-84	.10695	26,469	2,831	25,053	157,791	5.96
84-85	.11548	23,638	2,730	22,273	132,738	5.62
85-86	.12561	20,908	2,626	19,595	110,465	5.28
86-87	.13748	18,282	2,513	17,025	90,870	4.97
87-88	.14979	15,769	2,362	14,588	73,845	4.68
88-89	.16158	13,407	2,167	12,324	59,257	4.42
89-90	.17292	11,240	1,943	10,268	46,933	4.18
90-91	.18502	9,297	1,720	8,437	36,665	3.94
91-92	.19888	7,577	1,507	6.823	28,228	3.73
92-93	.21363	6,070	1,297	5,422	21,405	3.53
93-94	.22870	4,773	1,091	4,227	15,983	3.35
94-95	.24336	3,682	896	3,234	11,756	3.19
95-96	.25745	2,786	718	2,427	8,522	3.06
96-97	.26959	2,068	557	1,789	6,095	2.95
97-98	.28024	1,511	424	1,300	4,306	2.85
98-99	.28977	1,087	315	929	3,006	2.76
99-100	.29869	772	230	657	2,077	2.69
100-101	.30696	542	167	459	1,420	2.62
101-102	.31461	375	118	316	961	2.56
102-103	.32167	257	82	216	645	2.51
103-104	.32817	175	58	146	429	2.46
104-105	.33414	117	39	98	283	2.41
105-106	.33960	78	26	65	185	2.37
106-107	.34460	52	18	42	120	2.34
107-108	.34917	34	12	28	78	2.30
108-109	.35333	22	8	18	50	2.27
109-110	.35712	14	5	12	32	2.24

given in column 6, and column 7 lists the average years of life left, or life expectancy, for the survivors entering the age interval.

The survivors from each age interval proceed on to the succeeding one until the last reported age interval, 109-110, is reached. The years of life remaining for those who survive beyond age 110 are included in this age interval.

Throughout its "life" the cohort is subjected to the average probabilities of death calculated for the U.S. population during the years 1969-71 only. Thus the results from the life table analysis should be viewed as if the cohort lived its entire existence instantly, using the mortality data from that three year period. The life tables should not be interpreted as predicting future effects in a real population, since this is dependent on many unknown quantities, including future death probabilities. They are useful, however, for indicating relative changes which might occur under prevailing mortality conditions.

In a stationary population, 100,000 persons are assumed to be born every year and the proportions dying experienced by each age group is taken to be that listed in column 2. This yields an equilibrium population in which the number of people at a given age does not vary from year to year. The interpretation of life table data as a stationary population is potentially useful for certain risk situations, but is not advantageous for calculation of risk to the individual and therefore is not used in the code.

3. CAIRD LIFE TABLES

3.1 General Code Description

A simplified flow diagram of the process used in CAIRD to generate life tables is shown in Figure 1. The flowchart details the major steps used to calculate the effects of increased risks of death. In order of execution, these steps are:

1) calculation of age specific probability of death from radiation risk
2) calculation of age specific probability of death from accident risk
3) generation of the modified life table
4) calculation of radiation induced deaths by age, stage of life, and cancer type.
5) comparison of case results with reference data
6) output of results

The first two steps calculate the increase in the probability of death that corresponds to the increased risk of death resulting from exposing the population to a given risk situation. The incremental probabilities are added to the reference probability data, and a modified life table is generated. In the fourth step, calculations may be performed which categorize radiation induced deaths by type of cancer or by the stage of life (fetal, child, or adult) during which the dose is received, or both. The comparisons with the reference table are then performed followed by output of the results.

If the code is run for the case of no increased risk of death, the result is simply a facsimile of the NCHS life table (Table II). A comparison between the CAIRD version of the life table and Table I reveals certain modifications that have been made to accommodate analysis of incremental risks.

3.2 CAIRD Version of an NCHS Life Table

The CAIRD life table includes three columns not found in the reference life table. The first of these is the incremental probability of death (IXR) column, which shows the total increment to the reference probability of death from increased risks. The sum of this increment and the reference probability is shown in the total probability (TQXR) column. The third additional column is comprised of the number of deaths which are attributable to the increased risks of death (IXRLXR).

Since the example shown in Table II does not include an increased risk of death, the IXR and IXRLXR columns contain zeros. The total probability of death (TQXR) column is simply equal to the

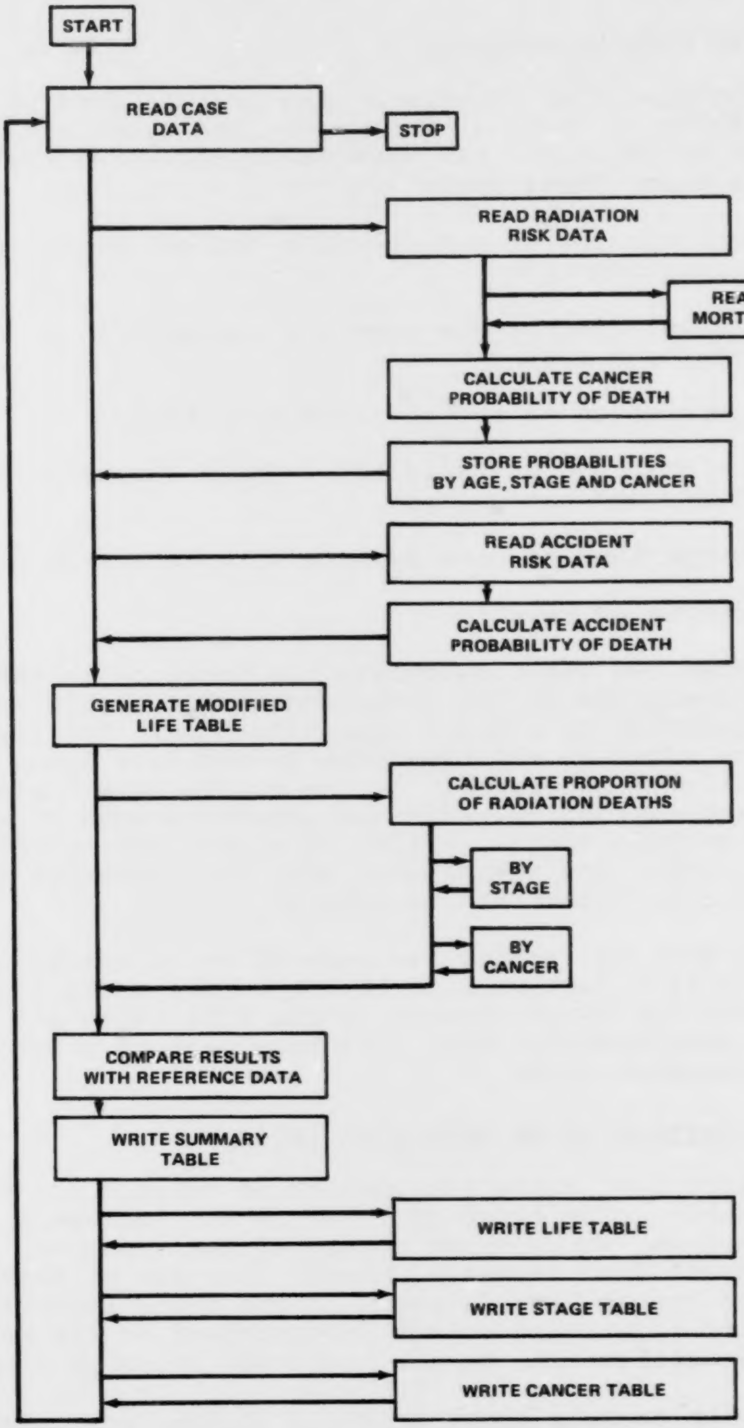

START
READ CASE DATA
STOP
READ RADIATION RISK DATA
READ CANCER MORTALITY DATA
CALCULATE CANCER PROBABILITY OF DEATH
STORE PROBABILITIES BY AGE, STAGE AND CANCER
READ ACCIDENT RISK DATA
CALCULATE ACCIDENT PROBABILITY OF DEATH
GENERATE MODIFIED LIFE TABLE
CALCULATE PROPORTION OF RADIATION DEATHS
BY STAGE
BY CANCER
COMPARE RESULTS WITH REFERENCE DATA
WRITE SUMMARY TABLE
WRITE LIFE TABLE
WRITE STAGE TABLE
WRITE CANCER TABLE

Figure 1

CAIRD Flow Diagram

TABLE II

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
0- 1	0.0200200000	0.0	0.0200200000	100000.0000	2002.0000	98999.0000	7075647.4998	70.756475	0.0
1- 2	0.0012449230	0.0	0.0012449230	97998.0000	122.0000	97937.0000	6976648.4998	71.191744	0.0
2- 3	0.0008582290	0.0	0.0008582290	97876.0000	84.0000	97834.0000	6878711.4998	70.279859	0.0
3- 4	0.0006953530	0.0	0.0006953530	97792.0000	68.0000	97758.0000	6780877.4998	69.339798	0.0
4- 5	0.0005730420	0.0	0.0005730420	97724.0001	56.0000	97696.0001	6683119.4997	68.387699	0.0
5- 6	0.0005017000	0.0	0.0005017000	97668.0001	49.0000	97643.5001	6585423.4997	67.426624	0.0
6- 7	0.0004712200	0.0	0.0004712200	97619.0001	46.0000	97596.0000	6487779.9996	66.460218	0.0
7- 8	0.0004304470	0.0	0.0004304470	97573.0000	42.0000	97552.0000	6390183.9995	65.491314	0.0
8- 9	0.0003793670	0.0	0.0003793670	97531.0000	37.0000	97512.5000	6292631.9995	64.519302	0.0
9- 10	0.0003487390	0.0	0.0003487390	97494.0000	34.0000	97477.0000	6195119.4995	63.543598	0.0
10- 11	0.0003078190	0.0	0.0003078190	97460.0000	30.0000	97445.0000	6097642.4995	62.565591	0.0
11- 12	0.0002976500	0.0	0.0002976500	97430.0000	29.0000	97415.5000	6000197.4995	61.584702	0.0
12- 13	0.0003490720	0.0	0.0003490720	97400.9999	34.0000	97384.0000	5902781.9995	60.602889	0.0
13- 14	0.0004621690	0.0	0.0004621690	97367.0000	45.0000	97344.5000	5805397.9995	59.623877	0.0
14- 15	0.0006267850	0.0	0.0006267850	97322.0000	61.0000	97291.5000	5708053.4996	58.651215	0.0
15- 16	0.0008225290	0.0	0.0008225290	97261.0000	80.0000	97221.0000	5610761.9996	57.687686	0.0
16- 17	0.0010084280	0.0	0.0010084280	97181.0000	98.0000	97132.0000	5513540.9996	56.734763	0.0
17- 18	0.0011639520	0.0	0.0011639520	97083.0000	113.0000	97026.5000	5416408.9996	55.791529	0.0
18- 19	0.0012787460	0.0	0.0012787460	96970.0000	124.0000	96908.0000	5319382.4996	54.855961	0.0
19- 20	0.0013423370	0.0	0.0013423370	96846.0000	130.0000	96781.0000	5222474.4995	53.925557	0.0
20- 21	0.0014061790	0.0	0.0014061790	96716.0001	136.0000	96648.0000	5125693.4995	52.997369	0.0
21- 22	0.0014702840	0.0	0.0014702840	96580.0000	142.0000	96509.0000	5029045.4995	52.071293	0.0
22- 23	0.0015139260	0.0	0.0015139260	96438.0000	146.0000	96365.0000	4932536.4994	51.147229	0.0
23- 24	0.0015266070	0.0	0.0015266070	96292.0000	147.0000	96218.5000	4836171.4994	50.224022	0.0
24- 25	0.0015081390	0.0	0.0015081390	96145.0000	145.0000	96072.5000	4739952.9994	49.300047	0.0
25- 26	0.0014687500	0.0	0.0014687500	96000.0000	141.0000	95929.5000	4643880.4994	48.373755	0.0
26- 27	0.0014396140	0.0	0.0014396140	95859.0000	138.0000	95790.0000	4547950.9995	47.444173	0.0
27- 28	0.0014103490	0.0	0.0014103490	95721.0000	135.0000	95653.5000	4452160.9995	46.511852	0.0
28- 29	0.0014437260	0.0	0.0014437260	95586.0000	138.0000	95517.0000	4356507.4995	45.576837	0.0
29- 30	0.0014772440	0.0	0.0014772440	95448.0000	141.0000	95377.5000	4260990.4995	44.642009	0.0
30- 31	0.0015633690	0.0	0.0015633690	95307.0000	149.0000	95232.5000	4165612.9995	43.707314	0.0
31- 32	0.0016288700	0.0	0.0016288700	95158.0000	155.0000	95080.5000	4070380.4995	42.774969	0.0
32- 33	0.0017157350	0.0	0.0017157350	95003.0000	163.0000	94921.5000	3975299.9996	41.843942	0.0
33- 34	0.0018346690	0.0	0.0018346690	94840.0000	174.0000	94753.0000	3880378.4996	40.914999	0.0
34- 35	0.0019436760	0.0	0.0019436760	94666.0000	164.0000	94574.0000	3785625.4996	39.989283	0.0
35- 36	0.0020850530	0.0	0.0020650530	94482.0000	197.0000	94383.5000	3691051.4996	39.066187	0.0
36- 37	0.0022485020	0.0	0.0022485020	94285.0000	212.0000	94179.0000	3596667.9996	38.146768	0.0
37- 38	0.0024449100	0.0	0.0024449100	94073.0000	230.0000	93958.0000	3502488.9996	37.231607	0.0
38- 39	0.0026640240	0.0	0.0026640240	93843.0000	250.0000	93718.0000	3408530.9996	36.321633	0.0
39- 40	0.0028955160	0.0	0.0028955160	93593.0000	271.0000	93457.4999	3314812.9997	35.417318	0.0

TABLE II (cont.)

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
40- 41	0.0031503820	0.0	0.0031503820	93321.9999	293.9999	93175.0000	3221355.4997	34.518715	0.0
41- 42	0.0033968270	0.0	0.0033968270	93028.0000	316.0000	92870.0000	3128180.4998	33.626225	0.0
42- 43	0.0037104150	0.0	0.0037104150	92712.0000	344.0000	92540.0000	3035310.4996	32.739133	0.0
43- 44	0.0040381950	0.0	0.0040381950	92368.0000	373.0000	92181.5000	2942770.4999	31.859199	0.0
44- 45	0.0044350240	0.0	0.0044350240	91995.0000	408.0000	91791.0000	2850588.9999	30.986347	0.0
45- 46	0.0048369310	0.0	0.0048369310	91586.9999	443.0000	91365.4999	2758797.9999	30.122157	0.0
46- 47	0.0052883350	0.0	0.0052883350	91143.9999	482.0000	90902.9999	2667432.5000	29.266134	0.0
47- 48	0.0057355890	0.0	0.0057355890	90661.9999	520.0000	90401.9999	2576529.5001	28.419068	0.0
48- 49	0.0062457010	0.0	0.0062457010	90142.0000	563.0000	89860.5000	2486127.5001	27.580124	0.0
49- 50	0.0067761420	0.0	0.0067761420	89579.0000	607.0000	89275.5000	2396267.0002	26.750321	0.0
50- 51	0.0073843460	0.0	0.0073843460	88972.0000	657.0000	88643.4999	2306991.5002	25.929410	0.0
51- 52	0.0080394040	0.0	0.0080394040	88314.9999	710.0000	87959.9999	2218348.0002	25.118587	0.0
52- 53	0.0087552080	0.0	0.0087552080	87605.0000	767.0000	87221.5000	2130388.0003	24.318110	0.0
53- 54	0.0095695430	0.0	0.0095695430	86838.0000	831.0000	86422.5000	2043166.5003	23.528484	0.0
54- 55	0.0104293840	0.0	0.0104293840	86007.0000	897.0000	85558.5000	1956744.0004	22.750985	0.0
55- 56	0.0113735170	0.0	0.0113735170	85110.0000	968.0000	84625.9999	1871185.5004	21.985495	0.0
56- 57	0.0123481730	0.0	0.0123481730	84141.9999	1039.0000	83622.4999	1786559.5004	21.232672	0.0
57- 58	0.0134170850	0.0	0.0134170850	83103.0000	1115.0000	82545.5000	1702937.0005	20.491884	0.0
58- 59	0.0145143190	0.0	0.0145143190	81987.9999	1190.0000	81393.0000	1620391.5006	19.763764	0.0
59- 60	0.0157058340	0.0	0.0157058340	80798.0000	1269.0000	80163.5000	1538998.5006	19.047483	0.0
60- 61	0.0169497920	0.0	0.0169497920	79529.0000	1348.0000	78855.0000	1458835.0006	18.343434	0.0
61- 62	0.0182908890	0.0	0.0182908890	78181.0000	1430.0000	77466.0000	1379980.0007	17.651092	0.0
62- 63	0.0197391560	0.0	0.0197391560	76751.0000	1515.0000	75993.5000	1302514.0007	16.970645	0.0
63- 64	0.0213328730	0.0	0.0213328730	75236.0000	1605.0000	74433.5000	1226520.5007	16.302309	0.0
64- 65	0.0230609390	0.0	0.0230609390	73631.0000	1698.0000	72782.0000	1152087.0007	15.646766	0.0
65- 66	0.0249398750	0.0	0.0249398750	71933.0000	1794.0000	71036.0000	1079305.0007	15.004310	0.0
66- 67	0.0269892640	0.0	0.0269892640	70139.0000	1893.0000	69192.5000	1008269.0007	14.375298	0.0
67- 68	0.0291885240	0.0	0.0291885240	68246.0000	1992.0000	67250.0000	939076.5007	13.760169	0.0
68- 69	0.0315150780	0.0	0.0315150780	66254.0000	2088.0000	65210.0000	871826.5008	13.158851	0.0
69- 70	0.0340055480	0.0	0.0340055480	64166.0000	2182.0000	63075.0000	806616.5008	12.570777	0.0
70- 71	0.0366062210	0.0	0.0366062210	61984.0000	2269.0000	60849.5000	743541.5008	11.995701	0.0
71- 72	0.0394373270	0.0	0.0394373270	59715.0000	2355.0000	58537.5000	682692.0008	11.432504	0.0
72- 73	0.0426603900	0.0	0.0426603900	57360.0000	2447.0000	56136.5000	624154.5008	10.881355	0.0
73- 74	0.0464370910	0.0	0.0464370910	54913.0000	2550.0000	53638.0001	568018.0008	10.343962	0.0
74- 75	0.0507610340	0.0	0.0507610340	52363.0001	2658.0000	51034.0000	514380.0007	9.823349	0.0
75- 76	0.0555074940	0.0	0.0555074940	49705.0000	2759.0000	48325.5000	463346.0007	9.321919	0.0
76- 77	0.0606015420	0.0	0.0606015420	46946.0000	2845.0000	45523.5000	415020.5006	8.840380	0.0
77- 78	0.0659622230	0.0	0.0659622230	44101.0001	2909.0000	42646.5001	369497.0006	8.378427	0.0
78- 79	0.0715430180	0.0	0.0715430180	41192.0001	2947.0000	39718.5000	326850.5005	7.934805	0.0
79- 80	0.0773957380	0.0	0.0773957380	38245.0000	2960.0000	36765.0000	287132.0005	7.507700	0.0

TABLE II (cont.)

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
80- 81	0.0839450190	0.0	0.0839450190	35285.0000	2962.0000	33804.0000	250367.0004	7.095565	0.0
81- 82	0.0912044050	0.0	0.0912044050	32323.0000	2948.0000	30849.0001	216563.0004	6.699966	0.0
82- 83	0.0989276600	0.0	0.0989276600	29375.0001	2906.0000	27922.0002	185714.0003	6.322179	0.0
83- 84	0.1069553060	0.0	0.1069553060	26469.0000	2831.0000	25053.5000	157792.0003	5.961389	0.0
84- 85	0.1154920040	0.0	0.1154920040	23638.0000	2730.0000	22273.0000	132738.5002	5.615471	0.0
85- 86	0.1255978570	0.0	0.1255978570	20908.0000	2626.0000	19595.0000	110465.5002	5.283408	0.0
86- 87	0.1374576090	0.0	0.1374576090	18282.0000	2513.0000	17025.5000	90870.5002	4.970490	0.0
87- 88	0.1497875580	0.0	0.1497875580	15769.0000	2362.0000	14588.0000	73845.0001	4.682922	0.0
88- 89	0.1616319830	0.0	0.1616319830	13407.0000	2167.0000	12323.5000	59257.0001	4.419855	0.0
89- 90	0.1728647690	0.0	0.1728647690	11240.0000	1943.0000	10268.5000	46933.5001	4.175578	0.0
90- 91	0.1850059160	0.0	0.1850059160	9297.0000	1720.0000	8437.0000	36665.0000	3.943745	0.0
91- 92	0.1988913820	0.0	0.1988913820	7577.0000	1507.0000	6823.5000	28228.0000	3.725485	0.0
92- 93	0.2136738060	0.0	0.2136738060	6070.0000	1297.0000	5421.5000	21404.5000	3.526277	0.0
93- 94	0.2285774150	0.0	0.2285774150	4773.0000	1091.0000	4227.5000	15983.0000	3.348628	0.0
94- 95	0.2433460080	0.0	0.2433460080	3682.0000	896.0000	3234.0000	11755.5000	3.192694	0.0
95- 96	0.2577171570	0.0	0.2577171570	2786.0000	718.0000	2427.0000	8521.5000	3.058686	0.0
96- 97	0.2693423600	0.0	0.2693423600	2068.0000	557.0000	1789.5000	6094.5000	2.947050	0.0
97- 98	0.2806088680	0.0	0.2806088680	1511.0000	424.0000	1299.0000	4305.0000	2.849107	0.0
98- 99	0.2897884080	0.0	0.2897884080	1087.0000	315.0000	929.5000	3006.0000	2.765409	0.0
99-100	0.2979274610	0.0	0.2979274610	772.0000	230.0000	657.0000	2076.5000	2.689767	0.0
100-101	0.3081180810	0.0	0.3081180810	542.0000	167.0000	458.5000	1419.5000	2.619004	0.0
101-102	0.3146666670	0.0	0.3146666670	375.0000	118.0000	316.0000	961.0000	2.562667	0.0
102-103	0.3190661480	0.0	0.3190661480	257.0000	82.0000	216.0000	645.0000	2.509728	0.0
103-104	0.3314285710	0.0	0.3314285710	175.0000	58.0000	146.0000	429.0000	2.451429	0.0
104-105	0.3333333330	0.0	0.3333333330	117.0000	39.0000	97.5000	283.0000	2.418803	0.0
105-106	0.3333333330	0.0	0.3333333330	78.0000	26.0000	65.0000	185.5000	2.378205	0.0
106-107	0.3461538460	0.0	0.3461538460	52.0000	18.0000	43.0000	120.5000	2.317308	0.0
107-108	0.3529411760	0.0	0.3529411760	34.0000	12.0000	28.0000	77.5000	2.279412	0.0
108-109	0.3636363640	0.0	0.3636363640	22.0000	8.0000	18.0000	49.5000	2.250000	0.0
109-110	0.3571428570	0.0	0.3571428570	14.0000	5.0000	11.5000	31.5000	2.250000	0.0

reference probability of death (TQX). In cases in which an increased risk of death is included, the IXR risk data are supplied to the main program by subroutines. A general description of the algorithms used in these subroutines is given in the next section.

Another dissimilarity between the NCHS and CAIRD life tables lies in the additional decimal places used in the CAIRD tables. The extended decimal fields are available because the ${}_tq_x$ data, from which all the column data are derived, have been recalculated to nine decimal places in the CAIRD version using the standard l_x and d_x data:

$${}_tq_x{}' = \frac{d_x}{l_x}$$

The recalculated data are accurate and significant to four decimal places. The remaining decimal places are artifical and have no real significance, but are used arbitrarily to represent the reference probabilities of death to nine places because in certain instances, the incremental probabilities of death are quite small. It is assumed that any resulting inaccuracy in the life table calculations does not significantly effect comparisons of results between different risk situations.

For each of the three populations (male, female, and total), a CAIRD life table has been generated without any incremental risk using the recalculated data. These tables are used as the source of ${}_tq_x$, l_x and T_x data in all generated tables, and are henceforth referred to as the reference life tables.

The CAIRD table differs from the NCHS table in two other respects. The first values for the TLXR and TXR columns are not in close agreement with their reference table counterparts, while the rest of the data are. The difference arises because the first age interval is given special consideration in the reference table. Since infant mortality rates are relatively high, the first year of life is broken down into quarterly time periods and the life table data are calculated separately for each period. The overall results for the four periods are used in the first age interval of the reference life table. The CAIRD table does not use this added sophistication, and the first age interval is treated in the same manner as all others.

The small differences arising between some of the other columns are attributable to the additional decimal places used in the CAIRD table and round-off error. CAIRD life tables for cases including an increased risk of death have the same basic features as those described above, and differ from reference tables in the same respects.

3.3 Calcualtion of Life Table Data

The CAIRD life table data are calculated in the code's main section. The table data are handled as elements of 2 arrays: a 2 x 110 integer array for the age interval data, and a 9 x 110 real number array for the life table data. The array data are produced by an iterative, two step process.[3]

During the first step, the following data are calculated or assigned progressively, from a user selected age (NORMAG see Glossary) through age 110. The equations provided below are equivalent to the code statements, but are written with the more tractable column heading notation. The subscript (i) denotes age in all equations.

1) Age intervals

$$\text{Intrvl2}(i) = i \qquad (1)$$

$$\text{Intrvl1}(i) = \text{Intrvl2}(i) - 1 \qquad (2)$$

2) Reference probability of death (TQX)

The reference probability of death data for the population under study must be supplied to the code. These probabilities express risk of death for those surviving at the beginning of an age interval. They are incompatible for addition to the mortality rates which result from increased risks of death, since mortality rates express risk to those surviving at the midpoint of the age inteval. The problem is reconciled by converting the reference probabilities of death to mortality rates, which are temporarily stored as values of REFMOR:*

$$\text{REFMOR} = \frac{{}_t q_x{}'}{1.0 - 0.5\ {}_t q_x{}'} \qquad (3)$$

The mortality rates due to increased risk are supplied to the main program by the risk subroutines:

$$\text{INCMOR} = \text{mortality rate } (i) \qquad (4)$$

The reference mortality rates are added to the incremental risk mortality rates to obtain the total mortality rate. Once the mortality rates are added, the respective components must be converted to probabilities of death because the remaining life table calculations require the probability format. The fraction of the total mortality which corresponds to the reference life table risks are converted to probabilities of death as follows:

$$\text{TQX}(i) = \frac{\text{REFMOR}}{1.0 + 0.5(\text{REFMOR} + \text{INCMOR})} \qquad (5)$$

3) Incremental probability of death (IXR)

The remaining fraction of the total mortality corresponds to the increased risk of death. The conversion equation to death probability is:

$$\text{IXR}(i) = \frac{\text{INCMOR}}{1.0 + 0.5(\text{REFMOR} + \text{INCMOR})} \qquad (6)$$

The total probability of death is the sum of the reference and incremental death probabilities:

$$TQXR(i) = TQX(i) + IXR(i) \quad (7)$$

4) Total number dying (DXR)

The number of individuals dying from both reference and incremental probabilities of death is next in the calculation sequence:

$$DXR(i) = TQXR(i) \times LXR(i) \quad (8)$$

The first value of LXR is taken from the reference table data.

5) Number surviving (LXR)

The number surviving is calculated for the succeeding (i+1) age interval by subtracting the number of deaths occurring in the current age interval from the number of survivors entering the current age interval:

$$LXR\ (i+1) = LXR(i) - DXR(i) \quad (9)$$

6) Average number surviving (TLXR)

The average number surviving in an age interval is the average of the number surviving at the beginning of the current and succeeding age intervals. This quantity may also be regarded as the number of person-years of life lived during the age interval:

$$TLXR(i) = \frac{LXR(i) + LXR(i+1)}{2} \quad (10)$$

7) Number of premature deaths (IXRLXR)

Since the number of deaths in the cohort remains constant at 100,000, there can be no "excess" deaths. Incremental risks therefore result in deaths that simply occur before they would have had there been no increased risk of death. Fractional deaths are carried through all calculations.

$$IXRLXR(i) = IXR(i) \times LXR(i) \quad (11)$$

The data for the two remaining colums, TXR and EXR, are calculated during the second life table generation step. These calculations are performed regressively from age 110 to the user selected age because the two quantities begin with the final (age = 110) values for TLXR and LXR, respectively.

8) Years of life remaining (TXR)

The years of life remaining to the survivors in the 109-110 age internal is the sum of the years of life lived during that interval (age = 110 entry for TLXR) and all subsequent age intervals. The latter component is taken from the reference table data:

$$TXR(110) = TLXR(110) + \text{years lived after age } 110 \qquad (12)$$

The remaining TXR data are calculated as follows:

$$TXR(i-1) = TLXR(i-1) + TXR(i) \qquad (13)$$

9) Average years of life remaining (EXR)

The last table column calculated is the average years of life remaining to the cohort, or its life expectancy, and is the quotient of the years of life remaining and the number of survivors:

$$EXR(i) = \frac{TXR(i)}{LXR(i)} \qquad (14)$$

4. ANALYSIS OF INCREASED RISKS OF DEATH

The preceding sections have outlined the structure and content of NCHS life tables as well as the equations used in the code for generating modified life tables. While generation of life tables is the core of the code, the majority of the non-output sections is devoted to managing, calculating and storing the incremental risk data.

This section deals with the algorithms used to generate the age distributed mortality rates that result from exposing the cohort to risk situations. The two major risk categories which can be analyzed using CAIRD will be discussed individually first, follwed by an example which combines risks from both categories.

4.1 Accident Risk Analysis

There are, of course, many different types of risks of death For purposes of this analysis, these risks may be grouped into two broad categories; those which result in prompt deaths and those which result in delayed deaths.

Prompt deaths are perhaps best exemplified by those that result from accidents, for example; automobile collisions, falls and electrocutions. The causes of accidental deaths are generally easy to identify, and the corresponding annual mortality rates for the U.S. population are readily available for certain types of accidents.[5,6] Since such deaths may be assumed to occur in the same calendar year as the incidents initiating death, these rates can appropriately be used to assess accident risk effects using CAIRD.

In CAIRD accident analyses, the cohort is assumed to be composed entirely of members of a given occupational workforce. The accidental death rate for that occupation is then used to represent the risk of on the job fatalities. It should be noted, however, that the life table's reference mortality data, which represent the summation of risks from all causes of death, already contain the contribution from all occupational accidental deaths. Since the accidental death rate is added to reference mortality data in the cohort analysis, the risk of death from that occupation is, in a sense, double counted. Ideally, the accidental death contribution from all occupations should be subtracted from the reference data before the accident rate is added. This proves unnecessary, however, since the contribution of accidental deaths from the occupational workforce to the overall mortality rate of the U.S. population is exceedingly small (<1% of annual U.S. deaths due to occupational accidents). The impact of double counting, therefore, is negligible

In order to simulate employment under certain working conditions, accident risk cases require exposing the cohort over a range of ages. Consider a case in which a cohort of the total population is exposed to an industrial, annual accident risk of 50. $\times 10^{-6}$ between the ages of 20 and 30. Figure 2 shows the distribution of this risk across the ages of the cohort. This exposure situation exhibits a

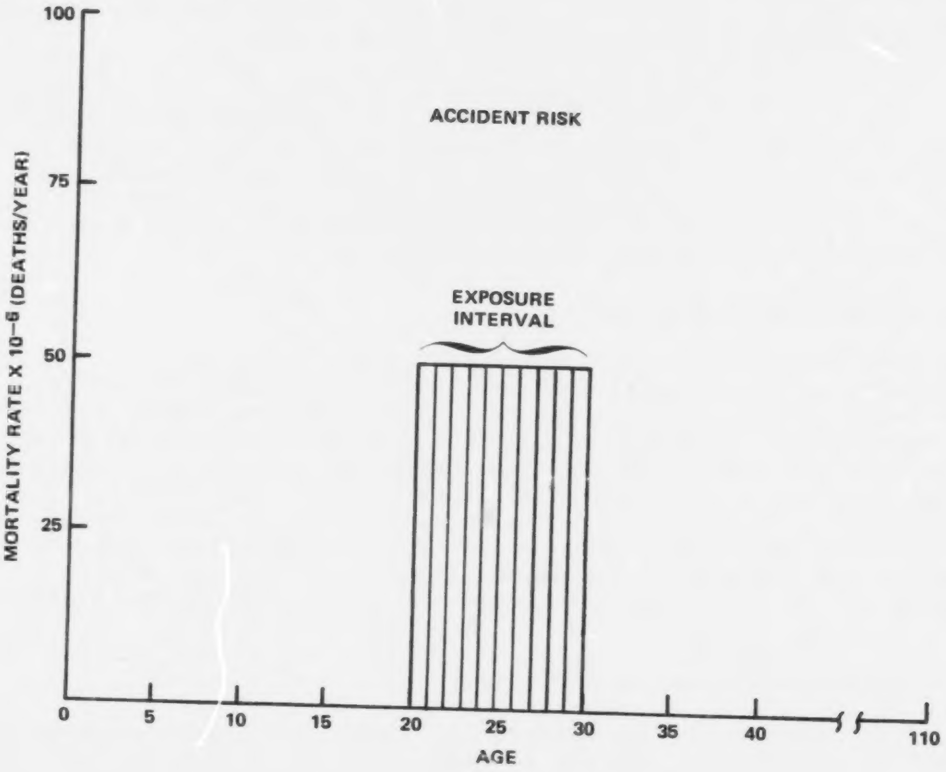


Figure 2

Age specific mortality rate distribution resulting from exposure to the cohort to an annual accident risk = 50. x 10^{-6} between the ages 20 and 30.

characteristic feature of the prompt death category; there is no accumulation of risk due to exposure in preceding ages. An area representing the annual risk rate has been entered for each age in the exposure interval. Since the cohort faces the risk of death only during the ages of exposure, all the resulting deaths occur in exposure interval.

The CAIRD code requires the age distribution of increased risk described above in order to generate a life table which corresponds to the exposure situation. For accident risk cases, the ACCRSK subroutine provides the risk distribution to the life table generating section of the code. The subroutine uses an array with the same number of elements as there are ages in the life table. The accident mortality rates are added to the appropriate ages of the array, which is subsequently used as the IXR column of the generated life table. The IXR data are added to the reference mortality data as described previously. The remainder of the life table is then generated, based on the sum of the incremental and reference rates. CAIRD results for this example may be examined by referring to problem 1 in the Sample Problems section.

The example above describes a case in which there is only one exposure interval, i.e., age 20-30. The code has provision, however, for accepting cases with multiple exposure intervals, each with a different risk level if desired. The user can directly submit an externally produced IXR array containing any mortality rate or probability of death distribution. For further details, consult the SWITCH case control parameter in the Glossary.

4.2 Radiation Risk Analysis

The code can also be used for risks of death which are delayed until sometime after the period of exposure. The risk of cancer death from low level radiation exposure falls into this category, and its accurate assessment requires information on the relationship between radiation dose and effects. The BEIR committee investigated various aspects of population doses, including parameters concerning the delay in death, models for estimating the risk of death and variations in radiosensitivity with age. The results of these studies have been used as the basis for the code's radiation risk algorithm. A short description of the consideration given the BEIR parameters in the code follows.

a. Latent and plateau periods

The delay which is observed in radiation induced deaths can be attributed to latent and plateau periods. In the code's context, the latent period is defined as the range of years following the exposure period during which there is no risk of radiation induced cancer death. The range of years following the latent period during which the risk of induced cancer death persists is called the plateau period. The risk of death is assumed to be uniformly distributed across the plateau period.

The delay in radiation induced deaths has an important consequence: the potential cancer victim experiences additional years of life which would otherwise be forfeited had the same individual fallen victim to an accident. Since the cancer may not appear for many years, or be immediately detected once it has, the potential cancer victim may not be aware of the pending illness. It is reasonable to assume that the potential victim maintains a normal lifestyle during this period and therefore is continually exposed to risks of death from normal daily activities. The fact that the individual is committed to die from cancer provides no immunity from other causes of death. Inevitably, a portion of the individuals previously committed to die from cancer will die from the competing causes of death.

Life tables are especially suited for calculating radiation exposure effects because they contain the age specific mortality rates from all causes of death. From the increased risk perspective, the mortality rates represent the risk of death from all competing causes, thus eliminating the need to account for every competing risk of death individually. Life tables provide a framework of the competing risks of death within which increased risks of death may be analyzed. A second advantage is that the latent period and the distribution of risk during the plateau period can be accurately represented because the mortality rates in the life tables are age specific.

b. Radiation risk models

The relationship between radiation dose and resulting risk of cancer death is not completely understood. Results from studies show that for some types of cancer, an absolute risk model is the best predictor for the number of deaths resulting from radiation dose. This model assumes that the normal cancer death rate is increased by an absolute number of cases per unit dose per unit population. For other cancer types, it appears that radiation dose results in a relative increase in the number of cancer deaths naturally occuring in the population: that is, a unit of radiation dose yields a percentage increase in the population's normal incidence of cancer. Since currently available data are insufficient to warrant the use of either model under all exposure conditions or for all types of cancer, the CAIRD code was designed to analyze radiation dose effects using either absolute or relative risk estimates.

c. Exposure stages

The response to radiation dose appears to be dependent on the age at which the dose is received. Consider radiation induced leukemia deaths as an example. For a given radiation dose, children have been found to suffer a higher incidence of leukemia than adults, and in utero doses are estimated to result in a still higher rate. Clearly, a single leukemia risk estimate could not reflect the different sensitivities observed at these life stages. Therefore, provision has been made to include three risk estimates, one each for the following life stages: fetal, child and adult.

d. Induced cancers

In addition to leukemia, radiation can induce cancer of the lung, liver, bone, breast as well as other organs. The code will accommodate up to nine types of cancer for each radiation dose. Each type of cancer may have a different risk estimate for each of the three exposure stages. Since latent and plateau periods may vary with the stage of exposure, the code will accommodate different values for these parameters for each cancer type as well. The code selects and uses the appropriate risk estimates based on the ages specified for the exposure interval.

4.3 Radiation Risk Distribution

a. Fetal stage dose

Analysis of fetal exposure cases is simplified by the fact that there is only one age interval during which doses can be received. Although the average gestation period might be more accurately represented by the ages -0.75 to 0, the code recognizes -1 to 0 as a fetal exposure case. It is assumed that there is no ill effect from the radiation during gestation, since the cohort analysis requires 100,000 live births. Unlike the annual dose input requried for child or adult stage exposures, the dose input for fetal exposure cases is the total dose received by each member of the cohort during the 9 month gestation period.

1) Absolute risk model

In the example illustrated Figure 3, it is assumed that each member of the cohort receives a 1.0 rem whole body fetal dose. Table III shows the latent and plateau periods and the absolute model risk data for in utero exposures as stated in the BEIR report.

The BEIR committee used a form of life table analysis in calculating the excess number of cancer deaths for certain exposure conditions. The risk estimates they provide are based on the number of cancer deaths observed in control and exposed populations. Since competing risks exist is both populations, their effect is canceled when the control data is subtracted from the exposed population data. Risk estimates derived in this manner can be used in subsequent competing risk analyses without double counting competing risk impacts.

For whole body exposure, the BEIR report estimates of risk are provided for two cancer types; leukemia and all other cancer types combined. The absolute risk estimate faced by the cohort is 25.0 deaths/10^6/rem/year for each cancer type. For in utero exposures, the plateau period is taken to be 10 years, with no latent period assumed. For the example in Figure 3, the reference probabilities of deaths for the first ten age intervals of the life table should therefore be increased by $50.\times10^{-6}$ ($25. \times 10^{-6}$ for each cancer type) to reflect the risk of death from the 1.0 rem in utero dose.

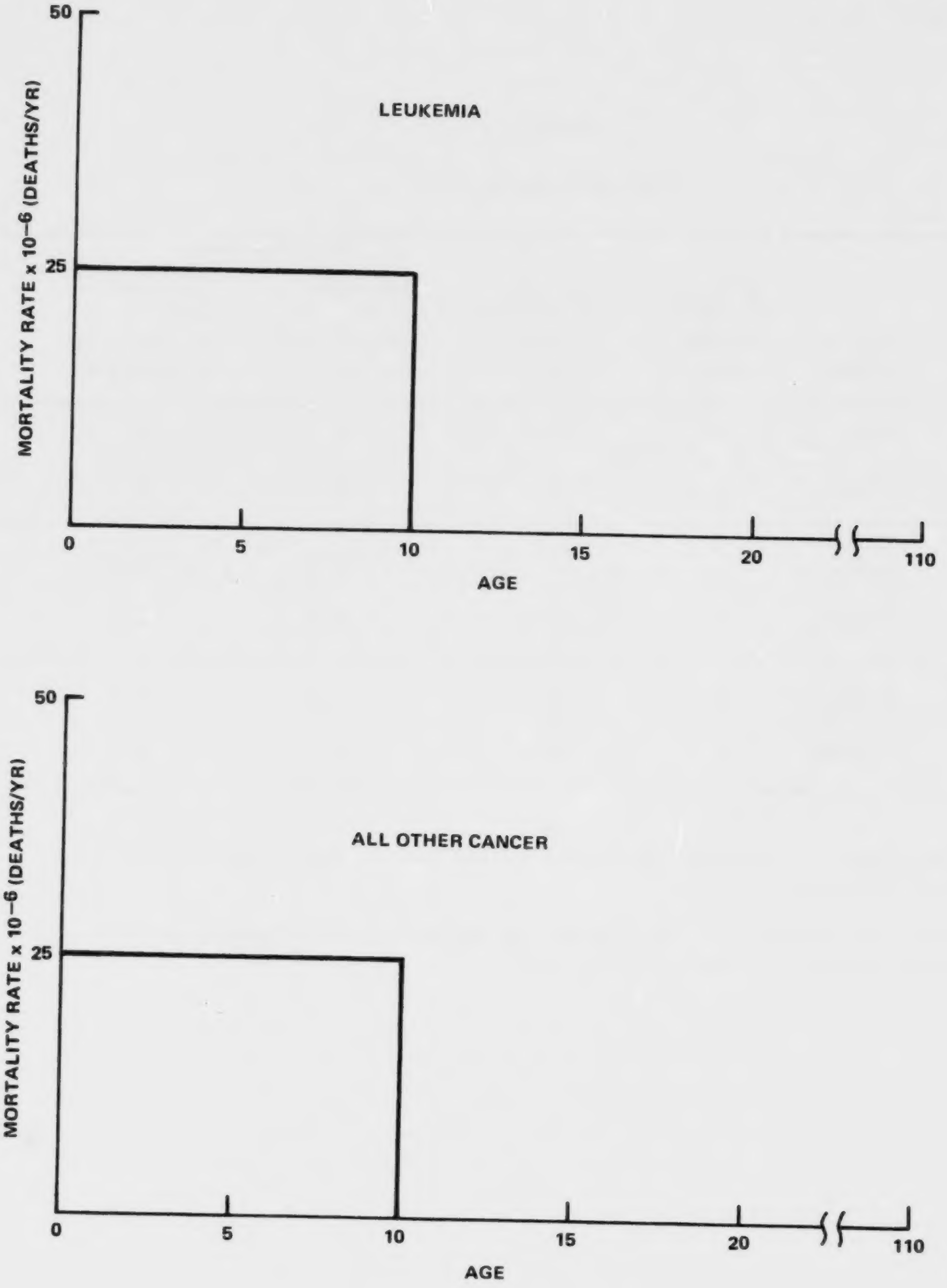


Figure 3

Age specific mortality rate distribution for leukemia and all other cancers following a 1.0 rem fetal stage (in utero) does to the cohort. BEIR absolute risk model data are used.

TABLE III

BEIR Risk Model Data

Age of Irradiation	Type of Cancer	Duration of Latent Period (years)	Duration of Plateau Region (years)*	Risk Estimate: Absolute Risk (deaths/10^6/yr/rem)	Risk Estimate: Relative Risk (% incr. in deaths/rem)
In Utero	Leukemia	0	10	25	50
	All other cancer	0	10	25	50
0-9 Years	Leukemia	2	25	2.0	5.0
	All other cancer	15	(a) 30 (b) Life	1.0	2.0
10 + Years	Leukemia	2	25	1.0	2.0
	All other cancer	15	(a) 30 (b) Life	5.0	0.2

* Plateau region = interval following latent period during which risk remains elevated.

Source: The Effects on Populations of Exposure to Low Levels of Ionizing Radiation, Table 3-2, p. 171

The figure shows the risk distributions for the example using the BEIR data. Since the latent period equals zero, the risk plateau period begins at birth. Unlike the accident case, the risk of death is not experienced in the exposure interval, nor is it confined to a single age interval, but is distributed uniformly over the first ten years of the cohort's life.

The code requires the numerical equivalent of the risk distributions in Figure 3 to generate the modified life table corresponding to the example. For fetal radiation exposure cases, these distributions are produced by the FETRSK subroutine.

The subroutine begins with the risk array, IXR. Using the latent and plateau data for the first cancer type, the risk estimate is added to the appropriate elements of the array. In the example, this would result in the $25.0X10^{-6}$ leukemia risk estimate being added to the elements for each age between 1 and 10, with the rest of the array retaining 0.0 values. The completed leukemia risk distribution is returned to the main program as the FETAL array.

The individual cancer risk distributions are stored in a three dimensional array called ALLCAN before being added to the life table. As shown in Figure 4, the ALLCAN array is designed to store age specific risk distribution for all three exposure stages of each cancer type. The ages, exposure stages and cancer types are represented by the rows, columns and planes of the array, respectively. The purpose in retaining the individual distributions is to enable calculation of the number of incremental deaths either by cancer type or by stage of exposure or by both.

As the data calculated by FETRSK are added to the appropriate column of the ALLCAN array, they are multiplied by the corresponding age and cancer entry of the CANMOR array. For absolute risk cases, CANMOR is initialized with values of 1.0 and hence has no effect on the data added to ALLCAN. Its purpose will be discussed in the relative risk model example to follow.

To obtain the total risk from a given cancer type, the risks for that cancer type from each stage of exposure must be summed. Similarly, the total risk for a given stage can be obtained by summing the contribution for that stage from each of the cancer types. Finally, summing the three stage subtotals or the cancer type subtotals will provide the total increased risk of death from all the stages of all the cancers. These summations are also performed as the data are read into the ALLCAN array.

In this example, the second and final cancer type is all other (non-leukemia) cancers. As with leukemia, the -1 beginning age of exposure calls the FETRSK subroutine, which generates the distribution and returns it to be stored, this time in the fetal stage of the all other cancer plane of ALLCAN. The data are added to the all other cancer total risk column and the fetus stage total risk column. Finally, the all other total risk is added to the all cancer column in

ALLCAN ARRAY

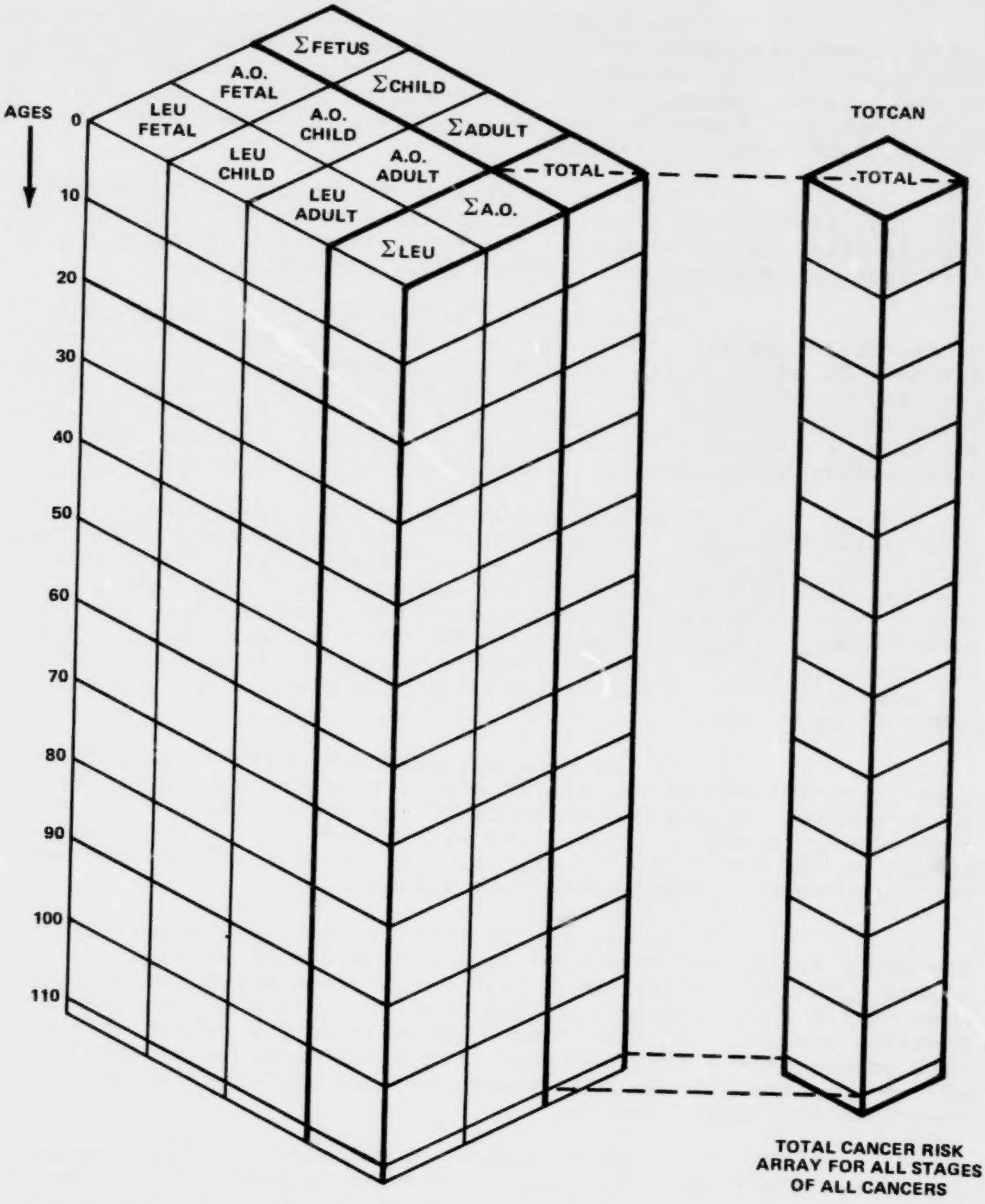

ΣFETUS
A.O. FETAL
ΣCHILD
LEU FETAL
A.O. CHILD
ΣADULT
AGES
0
LEU CHILD
A.O. ADULT
TOTAL
10
LEU ADULT
ΣA.O.
ΣLEU
20
30
40
50
60
70
80
90
100
110
TOTCAN
TOTAL
TOTAL CANCER RISK ARRAY FOR ALL STAGES OF ALL CANCERS

Figure 4

ALLCAN storage array for radiation induced cancer mortality data. The total cancer mortality array (TOTCAN) is the radiation risk input to the life table.

the third plane which already contains the leukemia total risk data. This is the sum of all risks resulting from the radiation dose, and is used as the radiation risk input to the increased probability of death column, IXR. The remainder of the life table is then generated on the basis of the combined radiation and reference mortality risks.

2) Relative risk model

Radiation exposure cases may also be analyzed using relative risk estimates. The procedure used differs slightly from that used for absolute risk. This may be demonstrated through reconsideration of the previous example using relative risk estimates. The BEIR absolute risk estimates are expressed as mortality rates, and since this format is required for the life table, these estimates can be used as initial input for the IXR column of the table. Relative risk estimates, however, are expressed as a percentage increase in the natural cancer mortality rate. It is therefore necessary to first supply the natural mortality rates to the code for the calculation of the number of deaths due to radiation exposure.

For relative risk cases, natural cancer mortality rates are read into the CANMOR array. After these data have been entered, examination of the beginning age of the first exposure interval causes FETRSK to be called. In a manner completely analogous to that used for absolute risks, the distribution of the percent increases in cancer is calculated using the leukemia latent and plateau periods as shown in Figure 5. The risk faced by the cohort in each age of the two plateau periods is thus a 50% increase in the natural mortality rate of the two cancer types.

FETRSK generates the leukemia risk distribution as percentage increases in the natural cancer mortality, and returns it as the FETAL array in the main program. As these increases in the natural cancer mortality rate data are added to ALLCAN, they are multiplied by the corresponding age and cancer entry of CANMOR. Since CANMOR now contains the natural cancer mortality rate data, the resulting product is the mortality rate due to the radiation dose.

Figure 6 shows the natural mortality rates for both leukemia and all other cancers for the first 20 age intervals.[7] As the distribution shown in Figure 5 is multiplied by natural mortality rates in Figure 6, the mortality rate due to radiation is calculated (shaded portion of bars in Figure 6). The resulting mortality rate distributions are stored in the ALLCAN array in the same manner as the absolute risk data. This procedure is performed for each cancer type using its own natural mortality rate data. The sum of the leukemia and all other cancer mortality rates again serves as the initial radiation risk input to the IXR column.

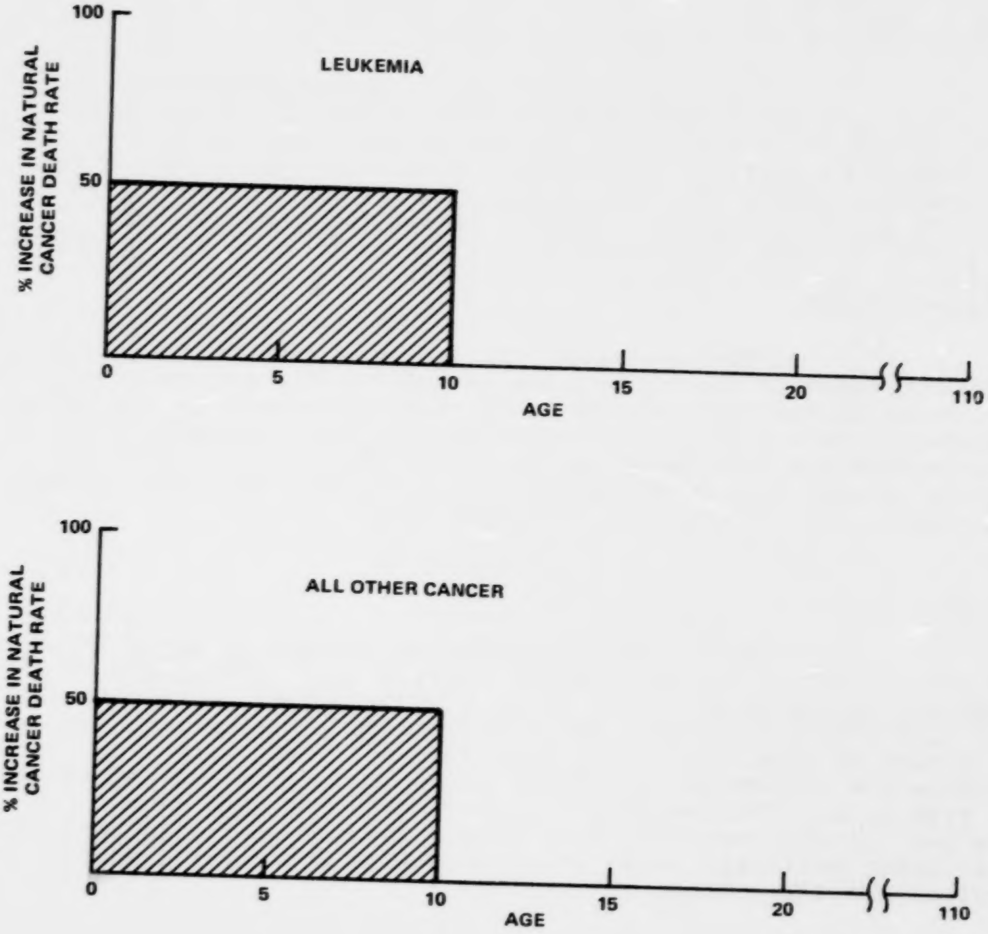
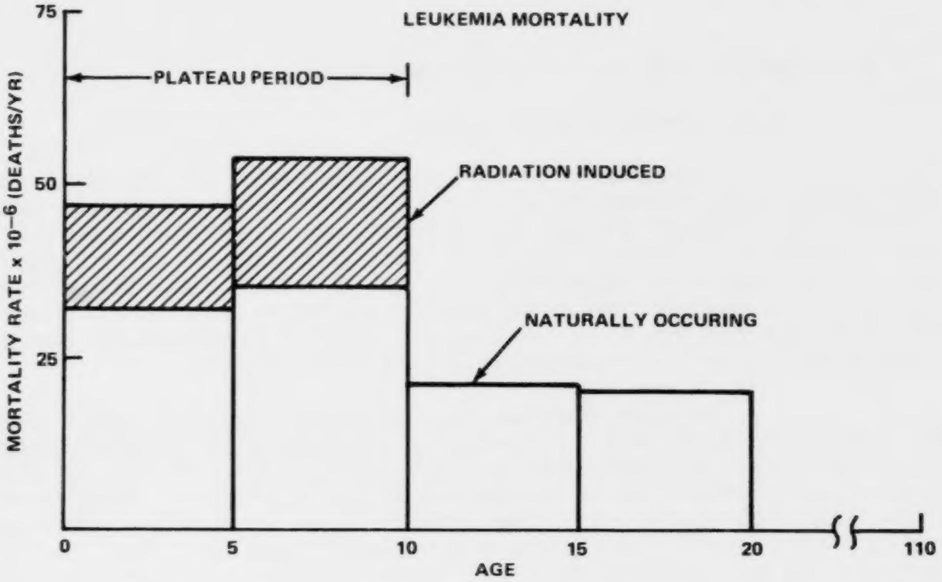


Figure 5

Age specific percentage increase in normal caner mortality for leukemia and all other cancer following a 1.0 rem fetal stage (in utero) dose to the cohort. BEIR relative risk model data are used.



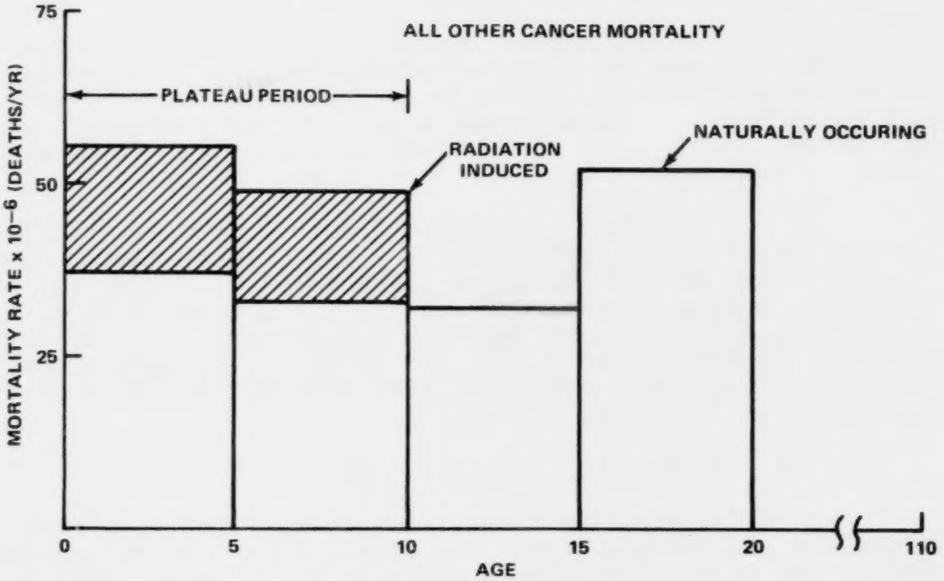


Figure 6

Age specific radiaton induced mortality rates for leukemia and all other cancer following a 1.0 rem fetal stage (in utero) dose to the cohort. Naturally occurring 5-year cancer mortality rates shown for ages 0-20 were calculated from NCHS data. Radiation induced mortalities (shaded bars) during the plateau period are products of age specific % increase data (Figure 5) and naturally occurring mortality rates.

b. Child and adult stage exposures

1) Absolute risk model

The cohort's 110 age intervals are divided into child and adult life stages by a user selected age. Exposure intervals that include the separation age are permitted: the code uses the appropriate latent, plateau, and risk data for the child and adult segments of the exposure interval. Child or adult risk distributions are calculated in nearly the same manner as those for fetal stage doses. The distributions may be more complex, however, since it is possible to expose the population over consecutive age intervals.

Figure 7 shows the leukemia and all other cancer absolute risk distributions following a 1.0 rem dose to the cohort for an adult stage exposure between the ages 20 and 30. Child or adult stage doses are assumed to be accumulated at a constant rate over each age in the exposure interval. The cohort does not accumulate the full annual dose, therefore, until the end of each exposure age. Since a year is required to receive the full dose, a year is also required for the cohort to reach the full risk level during the plateau period. The assumption of chronic dose accounts for the one year extension of the plateau periods shown in Figure 7, as well as the gradual risk increase during the first, and decrease in the last, plateau ages.

The individual cancer risk distributions for each exposure age interval are pictured as parallelograms. The total risk for multiple annual exposure intervals is shown as a stacked set of the individual distributions, each offset a year by the succeeding ages of exposure. Differences in the cancer risk produces risk distributions of different slope and size.

The CARSK subroutine generates the numerically equivalent cancer risk distributions for child and/or adult exposure cases. Once the exposure stage for a given case is determined, the code selects the appropriate latent, plateau and risk estimate data, and produces the risk distributions for each cancer type. The distribution data are stored in the ALLCAN array, and added to the life table mortality rates. The total radiation risk used as initial input to the IXR column is shown outlined in Figure 7.

2) Relative risk model

As with fetal stage exposures, relative risk cases require input of the natural cancer incidence rates for the cancer types under study. The CARSK subroutine generates the relative risk cancer distributions in the same manner as that used for absolute risk. Using the percentage increases as in the fetal exposure example, the distribution data are multiplied by the appropriate CANMOR entry as they are stored in the ALLCAN array. The resulting cancer mortality rates are subsequently added to the IXR column of the life table, translated to probabilities of death, and then used to generate the remainder of the table.

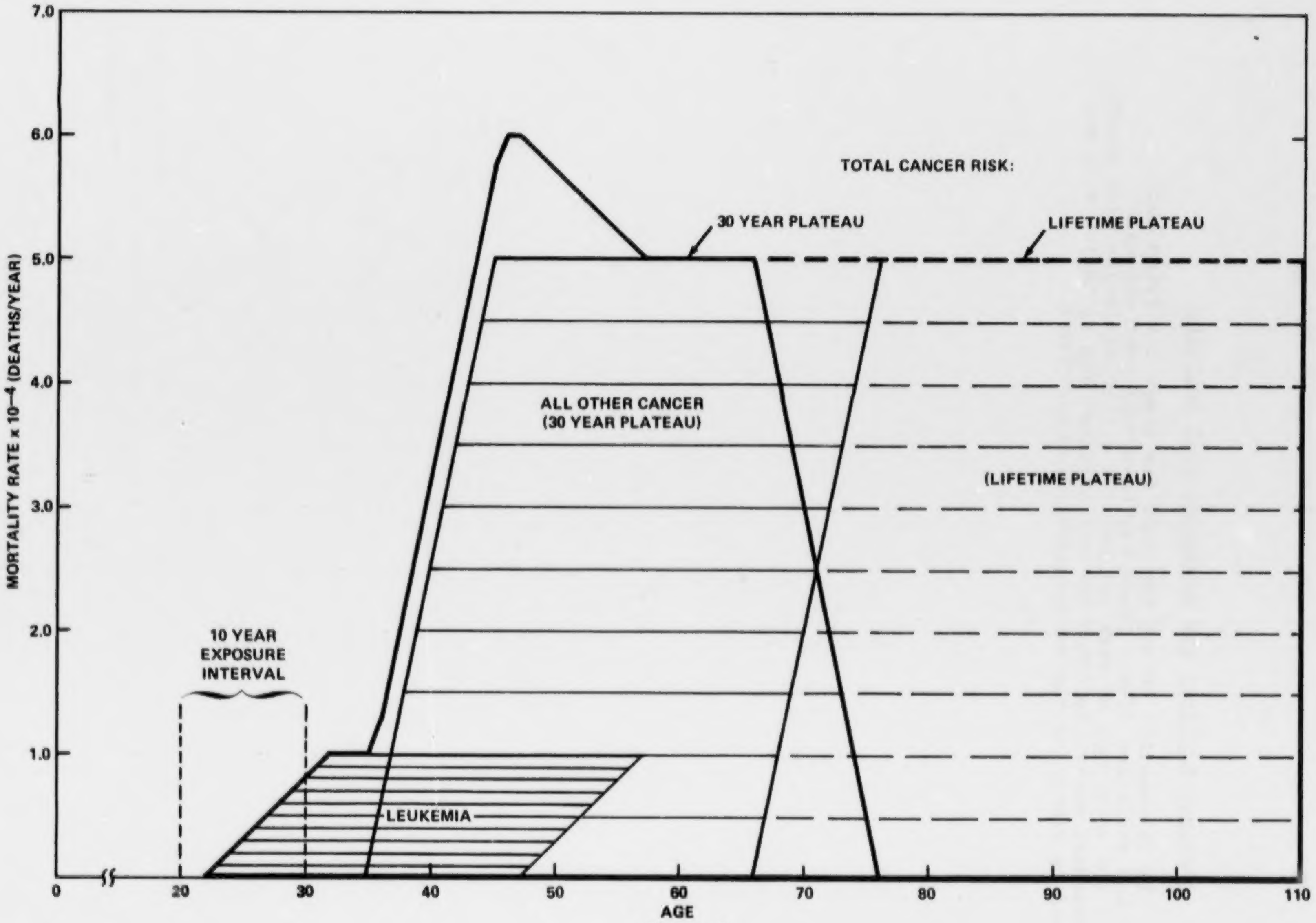


Figure 7

Age specific mortality rate distribution for leukemia and all other cancer following a 1.0 rem annual dose to cohort from age 20 to 30. BEIR absolute risk model data are used. Small parallelograms represent risk of death from leukemia - the larger one, risk of death from all other cancer assuming 30 year plateau period. If lifetime plateau assumed, area inside dashed lines included in all other cancer risk. Heavy solid line shows total cancer risk for 30 year plateau; heavy dashed line shows added total risk for lifetime plateau.

4.4 Combined Accident and Radiation Risk Analysis

It is possible to use the code for cases involving both accident and radiation risk. These may have different exposure intervals for each type of risk and may use either radiation risk model. The incremental mortality rates for the accident and radiation risk are determined by combining the methods described previously.

5. CAIRD SUMMARY TABLES

The code generates a summary table for each case analyzed. This table includes all input data and results from comparisons between the generated life tables and the corresponding reference life tables. The following features may be examined in the summary tables shown for sample problem 3.

5.1 Normalization of Output Data

Any age may be selected as the beginning of an exposure interval. Since each age begins with a different number of survivors, however, direct comparison of cases beginning at different ages might be misleading. To facilitate case comparisons, output data are normalized to 100,000 survivors at a user selected age, such as the beginning age of exposure. The generated life table, if requested, will be printed from the selected age through age 110.

5.2 Calculation of Output Data

The code uses 4 parameters for comparison between generated and reference life tables. The methods used in these comparisons are dicussed below:

1) Sum of premature deaths

$$< \mathrm{ADDEAD} = \sum_{i=1}^{110'} \mathrm{IXRLXR}(i) \quad \times \frac{100,000}{l_{x'}} \qquad (15)$$

where x = age selected for normalization

2) Years of life lost

The code calculates the years of life lost due to premature deaths. The comparison is made by subtracting the total years of life left to the cohort in the generated life table from the years left to reference cohort at the age selected for normalization:

$$\mathrm{YLL} = (t_{x'} - \mathrm{TXR}(x)) \times \frac{100,000}{l_{x'}} \qquad (16)$$

3) Average years of life lost

The average years of life lost per premature death is:

$$\mathrm{AVGYLL} = \frac{\mathrm{YLL}}{\mathrm{ADDEAD}} \qquad (17)$$

4) Decrease in life expectancy

If the years of life lost is divided by the initial cohort size, the quotient is the decrease in cohort's life expectancy:

$$\mathrm{DLE} = \frac{\mathrm{YLL}}{100,000} \qquad (18)$$

5.3 Premature Death Breakdowns

The generated life tables list the number of deaths for each age due to all incremental risks in the IXRLXR column. The normalized sum of this column is the first entry in the output data section of the summary table. For cases including radiation exposure, a breakdown of deaths by cancer type and stage of exposure is also provided.

The subtotals for radiation and accident risk are produced by using the accident risk array to subtract the number of accidental deaths from the total number of deaths in IXRLXR column. The remaining deaths in IXRLXR are due to radiation and are further categorized by using the cancer and stage risk distributions stored in the ALLCAN array. The subtotals for these categories are shown in the summary table. Tables of the age distribution of radiation death by cancer type or stage of exposure may be obtained through use of output options.

Although the results in the output data section of summary table are normalized to 100,000 at a user selected age, the radiation death subtotals and distribution tables are normalized at age zero. The user selected age is not used for the latter data because the zero age results provide a baseline for determining normalization effects and there is little need to compare the subtotals or death distribution tables between cases.

6. REFERENCES

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6. Statistical Abstract of the United States, 1975, U.S. Department of Commerce, Bureau of the Census, 1975.

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APPENDIX A

Input Requirements

User Aids

Glossary

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INPUT REQUIREMENTS

Table I shows the data and sequence requirements for the CAIRD code. The quantity of input data required varies among cases, depending on the type of risk data available and the analysis desired. Special consideration is given to multiple case runs, as is explained in the USER AIDS section. The sample problems section illustrates typical input data and resulting output. A brief discussion of input data format follows. Consult the Glossary for additional details on input variables.

1) Title card - The first card is reserved for an alpha-numeric title or description of the case (or cases) that follow. The entire 80 column field is printed as the top centered line of the summary table (see sample problem output).

2) Parameter Control and Case Variables card - The data on this card set up the configuration the code uses in analyzing any risk data. By specifying the seven columns of the SWITCH array, the user can choose among many combinations of population, risk type and model, output, etc. The remaining data specify values for case variables. These include: the number of cancer types resulting from the radiation exposure (NOCAN), the age to be used in separating child and adult doses (SEPAGE), the age at which output data are to be normalized (NORMAG), and the beginning ages for up to 9 exposure intervals (BEGAGE).

3) The ending ages of the exposure intervals (ENDAGE) are coded to form sequential pairs with the beginning age data. The doses used for the exposure intervals (DOSE) are coded in order corresponding to the exposure intervals. The doses used only for radiation risk cases, and their units must match those of the cancer risk estimates used.

In our society, the 20th year of life is lived when one is referred to as being age 19. In the code, age 19 refers to the 19th birthday, not the 20th year of life. Hence the age interval 20-30 represents the time between the cohort's 20th and 30th birthdays.

The code is written so that adjacent exposure intervals are identical to single age intervals which encompass the same ages. One rem during the 20-25 and 25-30 age intervals, for example, is equivalent to the same dose of 1.0 rem during the 20-30 age interval. The only restriction on consecutive year exposure intervals is that they may not begin with the fetal stage. Hence, the exposure interval -1 to 10 is not permitted, but may be replaced by the two equivalent intervals, -1 to 0 and 0 to 10.

4) The remaining 6 doses are coded on this card. All unused case variable data should be coded 0.0.

5) Reference Life Table Data Cards - The largest source of input data is the reference life table data required for calculation of output statistics. The age specific values for 3 of the reference table columns, the probability of death, the number of survivors, and the

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number of years of life remaining, are input to CAIRD. The reference data are required for the male, female and total populations. Since these data do not change, the merits of storing the data on disk should be considered. Should data for a different population become available, they can be read from cards. The reference data used for the sample problems may be found in Appendix B.

6) Cancer Variables Card - Used only for cases where one of the risks being analyzed results in death by cancer induction (e.g., radiation exposure). The first two variables, CASREP and CANREP, are used for controlling input in multiple case runs (see User Aids and Glossary).

CANNO is a numerical identifier for each cancer type, and CANCER (3,N) is used for alpha numeric description of the cancer types.

This card also contains the fetal, child and adult stage latency, plateau, and risk estimate data for each cancer type. If the case being analyzed involves only a single stage of exposure, the other stage data should be coded as zeros.

7) Cancer Mortality Cards - Used in relative risk analyses. These cards are required for each cancer type analyzed. They are read once for the first relative risk case and retained for use in similar cases (see CANREP). Cancer mortality data are only available in abridged format. That is the mortality data are reported for five year intervals whereas the life table data are reported for each year. CAIRD assigns the five year values to each year in the interval, thus generating a format compatible with the life table. The last abridged mortality value is for ages 85+ and is used for ages 85-110 in the expanded format.

8) Single Non-radiation Risk Card - Used for exposure intervals involving the same accident risk rate. The single value (SINRSK) is assigned to each age in the exposure interval.

9) Multiple Non-Radiation Risk Cards - Used for cases involving age-dependent accident risk rates, e.g., to model several changes in occupations throughout the cohort's lifetime. ADDRSK must be provided with 110 entries.

TABLE I

CAIRD Input Data Sequence and Format

Card Sequence		Columns	Data	Format
CASE VARIABLES - Required for all cases:				
1.	1 Card	1-80	TITLE	20A4
2.	1 Card	1-7	SWITCH(7)	7I1
		10-15	NOCAN	I5
		16-20	SEPAGE	I5
		21-25	NORMAG	I5
		26-70	BEGAGE(9)	9I5
3.	1 Card	1-45	ENDAGE(9)	9I5
		46-76	DOSE(1-3)	3F10.9
4.	1 Card	1-60	DOSE(4-9)	6F10.9
5.	330 Cards	1-30	REFTBL(111,3,3)	3F10.9
CANCER VARIABLES - Required for radiation risk cases only:				
6.	N Cards*	1	CASREP	I1
		2	CANREP	I1
		3-5	CANNO	I3
		10-22	CANCER(3,N)	3A4
		26-30	FLTNCY	I5
		31-35	FPLATO	I5
		36-40	FDEATH	F5.0
		41-45	CLTNCY	I5
		46-50	CPLATO	I5
		51-55	CDEATH	F5.0
		56-60	ALATNCY	I5
		61-65	APLATO	I5
		66-70	ADEATH	F5.0
CANCER MORTALITY - Required for each cancer type for relative risk cases only:				
7.	3 Cards	1-80	MORTAL(22)	8F10.9
ACCIDENT MORTALITY - Required for single accident risk cases only:				
8.	1 Card	1-10	SINRSK	F10.0
ADDITIONAL MORTALITY - Required for multiple accident risk cases only:				
9.	14 Cards	1-80	ADCRSK(110)	8F10.0

*N = Number of cancer types

USER AIDS FOR DATA INPUT

A series of exposure cases which differ only by the cancer variable data may be analyzed without repetitious input of identical case variable data by the use of the CASREP variable. CASREP is input with the cancer variables for radiation risk cases and with accident variables for accident risk cases. It is used to determine the step to be executed after the current case is completed.

When CASREP is set equal to 1, execution resumes at the beginning of the code and a complete set of input data are required for the next case. When not set equal to 1, the current case variables are retained, and execution continues with the next cancer variables coded. Thus one set of case variables may be used with a series of different cancer or accident variables, each combination being analyzed as a separate case.

Input of duplicate cancer mortality data for a series of relative risk exposure cases may be avoided by using the CANREP variable. CANREP is input adjacent to CASREP on the cancer variables card. When set equal to 1, the next three cards in the input deck must contain the cancer mortality data for the current cancer type. When not set equal to 1, the current cancer mortality data are retained and used in risk calculations. Hence, cancer mortality data need only be entered for the first occurrence of each cancer type.

It is possible to analyze both absolute and relative risk cases in the same run. It is essential, however, that all absolute risk cases be grouped together and appear first in the input deck. This eliminates the need to reinitialize the CANMOR array after each case, which would be required otherwise.

GLOSSARY

Term	Definition
ACCRSK	Subroutine that calculates accidental risk arrays
ADDEAD	Sum of deaths due to incremental risk(s) of death
ADDRSK(AGE)	Array for age specific non-radiation risk distributions
ADEATH(CAN)	Array for adult stage exposure radiation risk estimates
ADEXP(J)	Array for adult exposure intervals
ADULT(AGE)	Array for adult stage exposure radiation risk distributions
AGE	Index for cohort's age
ALLCAN(AGE,STG,CAN)	Storage array for radiation risk distributions by individual cancer type and stage of exposure.
ALTNCY(CAN)	Array for adult stage exposure latent periods
APLATO(CAN)	Array for adult stage exposure plateau periods
ARCO(AGE)	Array for age specific accident risks expressed as probabilities of death. These risks are converted to mortality rates before being added to the reference table data
AVGYLL	Average years of life lost per premature death
BEGCAN	The first cancer type for which the portion of total deaths is to be calculated
BEGSTG	The first stage of exposure for which the portion of total deaths is to be calculated
BEGAGE(J)	Array for the beginning age of exposure intervals
CAN	Index for cancer type
CANCER (3,CAN)	Array for alphanumeric description of cancer types
CANMOR(AGE,CAN)	Array for age specific natural cancer mortality rates
CANNO	Identification number for each cancer type
CANREP	Input control variable for cancer mortality data

CARSK	Subroutine that calculates radiation risk distributions for child and adult stage exposures
CASREP	Input control variable for case variables data
CDEATH(CAN)	Array for child stage exposure, radiation risk estimates
CHILD(AGE)	Age specific radiation risk distribution for child stage exposure
CLTNCY(CAN)	Array for child stage exposure latent periods
CPLATO(CAN)	Array for child stage exposure plateau periods
DLE	Decrease in life expectancy for entire cohort resulting from increased risks of death
DOSE(J)	Array for annual radiation dose rates (or total dose for fetal stage exposures)
ENDAGE(J)	Array for the ending age of exposure intervals
FETAL(AGE)	Array for fetal stage exposure radiation risk distributions
FETRSK	Subroutine that calculates fetal exposure radiation risk distributions
FDEATH(CAN)	Array for fetal stage exposure radiation risk estimates
FLTNCY(CAN)	Array for fetal stage exposure latent periods
FPLATO(CAN)	Array for fetal stage exposure plateau periods
GLTABL(AGE,N)	Array for generated life table
I	Index for SWITCH parameters
INCMOR	Incremental risks of death expressed as mortality rates
INTAGE(AGE,2)	Age interval array
INTBLK	Indicator for initially addressed 5-age block of generated life table
J	Index for exposure interval sets
K	Index for alphanumeric description of cancer type
KIDEXP(J)	Array for duration of child stage exposure
L	Index for abridged cancer mortality data

LINE	Index for line of life table.
LSW1	Literal translations for SWITCH(1) user options
LSW2	Literal translations for SWITCH(2) user options
LSW3	Literal translations for SWITCH(3) user options
LSW4	Literal translations for SWITCH(4) user options
LSW5	Literal translations for SWITCH(5) user options
LSW6	Literal translations for SWITCH(6) user options
LSW7	Literal translations for SWITCH(7) user options
M	Index for radiation doses
MORTAL(AGE,CAN)	Array for age specific natural mortality rate for cancers in abridged format
NOARCO(AGE)	Array for age specific accident risks expressed as mortality rates. These risks do not require conversion before being added to reference table data
NOCAN	The number of cancer types resulting from the radiation dose specified
NORMAG	Age at which output data are normalized
NOWBLK	Indicator for current 5-age block of the generated life table
POP	Index for population
REFMOR	Reference risk of death from all causes expressed as mortality rates
REFTBL(AGE,REF,POP)	Storage array for male, female and total population reference life table data
SEPAGE	User selected age that separates child and adult life stages
SINRSK	Variable for single accident risk value
STATRF	User selected statistical reference year, used for normalization of results
STRTAG	Beginning age of adult stage exposure
SWITCH	SWITCH array data are used to specify the user options on seven case control parameters:

a) Population
SWITCH (1) = 0 End of run
= 1 Use male referene life table data
= 2 Use female reference life table data
= 3 Use general reference life table data

b) Input Source
SWITCH (2) = 1 Input reference life table data
= 2 Input reference life table data from cards

c) Risk Model
SWITCH (3) = 1 No radiation risk
= 2 Absolute radiation risk model case
= 3 Relative radiation risk model case

d) Additional Risk
SWITCH (4) = 1 No additional risk
= 2 Single value accident risk - no risk conversion required
= 3 Multiple value accident risk - no risk coversion required
= 4 Single value additional risk - conversion to mortality rate required
= 5 Multiple values additional risk - conversion to mortality rates required

e) Stage & Cancer Analysis
SWITCH (5) = 1 No proportional analysis
= 2 Provide portion of total deaths by stages in summary table
= 3 Provide portion of total deaths by cancers in summary table
= 4 Provide portion of total deaths by stages and cancers in summary table

f) Output
SWITCH (6) = 1 Summary table only
= 2 Summary table and generated life table
= 3 Summary table, generated life table and stage table
= 4 Summary table, generated life table and cancer table
= 5 Summary table, generated life table, stage table and cancer table

g) Dose Rates
SWITCH (7) = n n = number of dose rates (0-9)

TDEAD	Temporary storage array for the premature number of deaths
TITLE (20)	Array for alphanumeric description of cases

TOTCAN	Summary plane of the ALLIXR array for sum of all cancer types used
YLL	Years of life lost

APPENDIX B

Sample Problems

Reference Life Table Data

Cancer Mortality Data

Code Listing

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SAMPLE PROBLEMS

The first four sample problems correspond to the examples discussed in preceding sections. The remaining two problems exhibit additional input and output features of the code. In each case, the output is preceded by a listing of the input statements used in the problem.

The reference life table data are also required for these or any other problems. Due to the quantity of reference table data, however, it has proved convenient to have these data read directly from disk, thus eliminating the need to submit these data along with the other problem input. A listing of the reference table data used in the sample problems is provided in Table I.

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Sample Problem 1.

This problem deals with exposure of the total population to an accident risk of 5.0×10^{-5} for ages 20 to 30. The 0.0005 entry for the first DOSE is not used in any calculations, but to document the risk rate in the summary table. Note that the "*** END OF RUN ***" statement is actually the title input for the final (dummy) case in each run.

The "*** OUTPUT DATA ***" are normalized to 100,000 survivors at age 20 as requested (NORMAG = 20), whereas the "NUMBER OF DEATHS CAUSED BY NON-RADIATION RISKS" are normalized at age zero. The generated life table is provided for this problem (SWITCH(6) = 2)).

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

 EXPOSURE OF TOTAL POPULATION TO ACCIDENT RISK = 0.0005 BETWEEN AGES 20 - 30
3112121       0    0   20   20    0    0    0    0    0    0    0    0
   30    0    0    0    0    0    0    0    0    0.0005       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
    1   0.0005
 ***   END OF RUN   ***
```

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```
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                         EXPOSURE OF TOTAL POPULATION TO ACCIDENT RISK = 0.0005 BETWEEN AGES 20 - 30                                |
|                                                                                                                                    |
|                                                   POPULATION AT RISK: GENERAL                                                      |
|    NUMBER OF DOSE RATES: ONE                                                   REFERENCE TABLE INPUT SOURCE: DISK                  |
|    RADIATION RISK MODEL: NCNE                                                            ADDITIONAL ANALYSIS: NONE                 |
|         ADDITIONAL RISK: ACCIDENT (SINGLE)                                                  ADDITIONAL OUTPUT: LIFE TABLE          |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                 |                                                                  |
|                    ***   INPUT DATA   ***                       |                    ***   OUTPUT DATA   ***                       |
|                                                                 |                                                                  |
|            DOSE                           AGE INTERVAL          |                                                                  |
|             0.000500000                     20 -  30            |                                                                  |
|        CHILD AGE INTERVAL =                  0 -   0            |  NUMBER OF PREMATURE DEATHS =                          495.10376 |
|        ADULT AGE INTERVAL =                  0 - 110            |  DECREASE IN PCPULATION LIFE EXPECTANCY =                0.23953 |
|        OUTPUT DATA BASED ON AGE INTERVAL =  20 - 110            |  TOTAL YEARS OF LIFC LOST TO PREMATURE DEATHS =    23952.7891  |
|                                                                 |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =      48.37932 |
|                                                                 |                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                        NUMBER OF DEATHS CAUSED BY NON-RADIATION RISKS                                 479.31624                    |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                        TOTAL NUMBER OF INCREMENTAL DEATHS                                             495.10376                    |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
```

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
20- 21	0.0014058278	0.0004995237	0.0019053515	96716.0001	184.2780	96623.8611	5102527.3169	52.757841	48.3119
21- 22	0.0014699168	0.0004995076	0.0019694244	96531.7221	190.1119	96436.6661	5005903.4558	51.857600	48.2183
22- 23	0.0015135479	0.0004994967	0.0020130446	96341.6101	193.9400	96244.6402	4909466.7897	50.958945	48.1223
23- 24	0.0015262257	0.0004994936	0.0020257193	96147.6702	194.7682	96050.2861	4813222.1495	50.060726	48.0251
24- 25	0.0015077623	0.0004994982	0.0020072605	95952.9020	192.6025	95856.6008	4717171.8634	49.161326	47.9283
25- 26	0.0014683832	0.0004995080	0.0019678912	95760.2995	188.4459	95666.0766	4621315.2627	48.259198	47.8330
26- 27	0.0014392544	0.0004995153	0.0019387698	95571.8537	185.2918	95479.2078	4525649.1861	47.353368	47.7396
27- 28	0.0014099967	0.0004995226	0.0019095194	95386.5619	182.1425	95295.4906	4430169.9783	46.444383	47.6477
28- 29	0.0014433654	0.0004995143	0.0019428797	95204.4194	184.9707	95111.9340	4334874.4877	45.532282	47.5560
29- 30	0.0014768751	0.0004995059	0.0019763810	95019.4486	187.7946	94925.5513	4239762.5537	44.619945	47.4628
30- 31	0.0015633690	0.0	0.0015633690	94831.6540	148.2569	94757.5256	4144837.0024	43.707315	0.0
31- 32	0.0016288700	0.0	0.0016288700	94683.3971	154.2269	94606.2837	4050079.4768	42.774970	0.0
32- 33	0.0017157350	0.0	0.0017157350	94529.1702	162.1870	94448.0767	3955473.1931	41.843943	0.0
33- 34	0.0018346690	0.0	0.0018346690	94366.9832	173.1322	94280.4171	3861025.1165	40.915000	0.0
34- 35	0.0019436760	0.0	0.0019436760	94193.8510	183.0823	94102.3098	3766744.6994	39.989284	0.0
35- 36	0.0020850530	0.0	0.0020850530	94010.7687	196.0174	93912.7600	3672642.3895	39.066188	0.0
36- 37	0.0022485020	0.0	0.0022485020	93814.7512	210.9427	93709.2799	3578729.6296	38.146769	0.0
37- 38	0.0024449100	0.0	0.0024449100	93603.8086	228.8529	93489.3821	3485020.3496	37.231608	0.0
38- 39	0.0026640240	0.0	0.0026640240	93374.9557	248.7531	93250.5791	3391530.9675	36.321634	0.0
39- 40	0.0028955160	0.0	0.0028955160	93126.2026	269.6484	92991.3784	3298280.3884	35.417319	0.0
40- 41	0.0031503820	0.0	0.0031503820	92856.5542	292.5336	92710.2874	3205289.0100	34.518716	0.0
41- 42	0.0033968270	0.0	0.0033968270	92564.0206	314.4240	92406.8086	3112578.7226	33.626227	0.0
42- 43	0.0037104150	0.0	0.0037104150	92249.5966	342.2843	92078.4544	3020171.9141	32.739134	0.0
43- 44	0.0040381950	0.0	0.0040381950	91907.3123	371.1396	91721.7425	2928093.4596	31.859200	0.0
44- 45	0.0044350240	0.0	0.0044350240	91536.1726	405.9651	91333.1901	2836371.7172	30.986348	0.0
45- 46	0.0048369310	0.0	0.0048369310	91130.2075	440.7905	90909.8123	2745038.5271	30.122158	0.0
46- 47	0.0052883350	0.0	0.0052883350	90689.4170	479.5960	90449.6190	2654128.7148	29.266135	0.0
47- 48	0.0057355890	0.0	0.0057355890	90209.8210	517.4065	89951.1178	2563679.0958	28.419069	0.0
48- 49	0.0062457010	0.0	0.0062457010	89692.4145	560.1920	89412.3185	2473727.9781	27.580125	0.0
49- 50	0.0067761420	0.0	0.0067761420	89132.2225	603.9726	88830.2362	2384315.6595	26.750322	0.0
50- 51	0.0073843460	0.0	0.0073843460	88528.2499	653.7232	88201.3883	2295485.4233	25.929412	0.0
51- 52	0.0080394040	0.0	0.0080394040	87874.5267	706.4588	87521.2973	2207284.0350	25.118588	0.0
52- 53	0.0087552080	0.0	0.0087552080	87168.0679	763.1746	86786.4806	2119762.7377	24.318111	0.0
53- 54	0.0095695430	0.0	0.0095695430	86404.8933	826.8553	85991.4656	2032976.2571	23.528485	0.0
54- 55	0.0104293840	0.0	0.0104293840	85578.0380	892.5262	85131.7749	1946984.7915	22.750987	0.0
55- 56	0.0113735170	0.0	C.0113735170	84685.5118	963.1721	84203.9257	1861853.0166	21.985496	0.0
56- 57	0.0123481730	0.C	0.0123481730	83722.3396	1033.8179	83205.4307	1777649.0909	21.232673	0.0
57- 58	0.0134170850	0.0	0.0134170850	82688.5217	1109.4389	82133.8022	1694443.6602	20.491885	0.0
58- 59	0.0145143190	0.0	0.0145143190	81579.0828	1184.0648	80987.0504	1612309.8580	19.763765	0.0
59- 60	0.0157058340	0.0	0.0157058340	80395.0180	1262.6708	79763.6825	1531322.8076	19.047484	0.0

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
60- 61	0.0169497920	0.0	0.0169497920	79132.3471	1341.2768	78461.7087	1451559.1251	18.343436	0.0
61- 62	0.0182908890	0.0	0.0182908890	77791.0703	1422.8678	77079.6364	1373097.4163	17.651093	0.0
62- 63	0.0197391560	0.0	0.0197391560	76368.2025	1507.4439	75614.4806	1296017.7799	16.970647	0.0
63- 64	0.0213328730	0.0	0.0213328730	74860.7586	1596.9951	74062.2611	1220403.2994	16.302310	0.0
64- 65	0.0230609390	0.0	0.0230609390	73263.7636	1689.5312	72418.9980	1146341.0383	15.646767	0.0
65- 66	0.0249398750	0.0	0.0249398750	71574.2324	1785.0524	70681.7062	1073922.0403	15.004311	0.0
66- 67	0.0269892640	0.0	0.0269892640	69789.1800	1883.5586	68847.4007	1003240.3341	14.375299	0.0
67- 68	0.0291885240	0.0	0.0291885240	67905.6214	1982.0649	66914.5889	934392.9334	13.760171	0.0
68- 69	0.0315150780	0.0	0.0315150780	65923.5565	2077.5860	64884.7635	867478.3445	13.158852	0.0
69- 70	0.0340055480	0.0	0.0340055480	63845.9705	2171.1172	62760.4119	802593.5810	12.570779	0.0
70- 71	0.0366062210	0.0	0.0366062210	61674.8533	2257.6833	60546.0116	739833.1691	11.995702	0.0
71- 72	0.0394373270	0.0	0.0394373270	59417.1700	2343.2544	58245.5428	679287.1575	11.432506	0.0
72- 73	0.0426603900	0.0	0.0426603900	57073.9156	2434.7955	55856.5179	621041.6147	10.881356	0.0
73- 74	0.0464370910	0.0	0.0464370910	54639.1201	2537.2818	53370.4792	565185.0968	10.343964	0.0
74- 75	0.0507610340	0.0	0.0507610340	52101.8383	2644.7432	50779.4667	511814.6176	9.823350	0.0
75- 76	0.0555074940	0.0	0.0555074940	49457.0951	2745.2394	48084.4754	461035.1509	9.321921	0.0
76- 77	0.0606015420	0.0	0.0606015420	46711.8557	2830.8105	45296.4505	412950.6755	8.840383	0.0
77- 78	0.0659622230	0.0	0.0659622230	43881.0452	2894.4913	42433.7996	367654.2250	8.378429	0.0
78- 79	0.0715430180	0.0	0.0715430180	40986.5539	2932.3018	39520.4031	325220.4254	7.934808	0.0
79- 80	0.0773957380	0.0	0.0773957380	38054.2522	2945.2369	36581.6337	285700.0223	7.507703	0.0
80- 81	0.0839450190	0.0	0.0839450190	35109.0152	2947.2270	33635.4018	249118.3886	7.095568	0.0
81- 82	0.0912044050	0.0	0.0912044050	32161.7883	2933.2968	30695.1399	215482.9869	6.699969	0.0
82- 83	0.0989276600	0.0	0.0989276600	29228.4915	2891.5063	27782.7384	184787.8470	6.322182	0.0
83- 84	0.1069553060	0.0	0.1069553060	26336.9853	2816.8803	24928.5451	157005.1086	5.961393	0.0
84- 85	0.1154920040	0.0	0.1154920040	23520.1049	2716.3841	22161.9129	132076.5635	5.615475	0.0
85- 86	0.1255978570	0.0	0.1255978570	20803.7209	2612.9028	19497.2695	109914.6506	5.283413	0.0
86- 87	0.1374576090	0.0	0.1374576090	18190.8181	2500.4664	16940.5849	90417.3811	4.970496	0.0
87- 88	0.1497875580	0.0	0.1497875580	15690.3518	2350.2195	14515.2420	73476.7961	4.682929	0.0
88- 89	0.1616319830	0.0	0.1616319830	13340.1323	2156.1920	12262.0363	58961.5541	4.419863	0.0
89- 90	0.1728647690	0.0	0.1728647690	11183.9402	1933.3092	10217.2856	46699.5178	4.175587	0.0
90- 91	0.1850059160	0.0	0.1850059160	9250.6310	1711.4215	8394.9203	36482.2322	3.943756	0.0
91- 92	0.1988913820	0.0	0.1988913820	7539.2095	1499.4838	6789.4676	28087.3119	3.725498	0.0
92- 93	0.2136738060	0.0	0.2136738060	6039.7257	1290.5312	5394.4601	21297.8443	3.526293	0.0
93- 94	0.2285774150	0.0	0.2285774150	4749.1946	1085.5586	4206.4152	15903.3842	3.348649	0.0
94- 95	0.2433460080	0.0	0.2433460080	3663.6359	891.5312	3217.8703	11696.9689	3.192721	0.0
95- 96	0.2577171570	0.0	0.2577171570	2772.1048	714.4190	2414.8953	8479.0986	3.058722	0.0
96- 97	0.2693423600	0.0	0.2693423600	2057.6858	554.2219	1780.5748	6064.2033	2.947099	0.0
97- 98	0.2806088680	0.0	0.2806088680	1503.4639	421.8853	1292.5212	4283.6285	2.849173	0.0
98- 99	0.2897884080	0.0	0.2897884080	1081.5786	313.4289	924.8641	2991.1073	2.765502	0.0
99-100	0.2979274610	0.0	0.2979274610	768.1496	228.8529	653.7232	2066.2432	2.689897	0.0

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
100-101	0.3081180810	0.0	0.3081180810	539.2968	166.1671	456.2132	1412.5200	2.619189	0.0
101-102	0.3146666670	0.0	0.3146666670	373.1297	117.4115	314.4239	956.3067	2.562934	0.0
102-103	0.3190661480	0.0	0.3190661480	255.7182	81.5910	214.9227	641.8828	2.510118	0.0
103-104	0.3314285710	0.0	0.3314285710	174.1272	57.7107	145.2718	426.9601	2.452001	0.0
104-105	0.3333333330	0.0	0.3333333330	116.4165	38.8055	97.0137	281.6883	2.419660	0.0
105-106	0.3333333330	0.0	0.3333333330	77.6110	25.8703	64.6758	184.6746	2.379490	0.0
106-107	0.3461538460	0.0	0.3461538460	51.7406	17.9102	42.7855	119.9988	2.319236	0.0
107-108	0.3529411760	0.0	0.3529411760	33.8304	11.9401	27.8603	77.2132	2.282360	0.0
108-109	0.3636363640	0.0	0.3636363640	21.8903	7.9601	17.9102	49.3529	2.254557	0.0
109-110	0.3571428570	0.0	0.3571428570	13.9302	4.9751	11.4426	31.4426	2.257161	0.0

Sample Problem 2.

This problem refers to the two cases discussed in section 4.3A. Both cases are analyzed here in one run. The input data are documented in the summary table, whether they are used or not. It is advisable, therefore, to code zeros for unessential variable input to avoid later confusion as to what case was actually run.

The proper sequence, i.e., absolute risk cases before relative risk cases, is shown. The CASREP is set equal to 1 on the all other cancer card causes the next full case to be read. Note that since CANREP is set equal to 1 on the relative risk leukemia and all other cancer cards, subsequent input of that cancer's natural mortality data (abridged format) is required.

The summary table is expanded for cases which include radiation risk in order to document latent, plateau and risk data, as well as provide a breakdown of radiation deaths by stage and cancer. The radiation death breakdowns are always normalized at age zero.

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

 FETAL RADIATION DOSE TO TOTAL POPULATION = 1.0REM PER INDIVIDUAL: ABSOLUTE RISK
3121421         2     0     0    -1     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0          1.0          0.0          0.0
       0.0          0.0          0.0          0.0          0.0          0.0
12  1      LEUKEMIA                 0    10 25.0     0     0  0.0     0     0  0.0
12  2      ALL OTHER                0    10 25.0     0     0  0.0     0     0  0.0
 FETAL RADIATION DOSE TO TOTAL POPULATION = 1.0REM PER INDIVIDUAL: RELATIVE RISK
3131421         2     0     0    -1     0     0     0     0     0     0     0     0
    0     0     0     0     0     0     0     0     0          1.0          0.0          0.0
       0.0          0.0          0.0          0.0          0.0          0.0
11  1      LEUKEMIA                 0    10  0.5     0     0  0.0     0     0  0.0
 000031184 000035867 000021347 000020230 000016544 000016845 000021354 000028818
 000035454 000043871 000062375 000100071 000140089 000225118 000348896 000467433
 000590330 000740884 000740884 000740884 000740884 000740884
11  2      ALL OTHER                0    10  0.5     0     0  0.0     0     0  0.0
 000037031 000032554 000032216 000052229 000071818 000110358 000196325 000339229
 000758201 001319668 002196321 003419671 004364605 006583333 008509636 010022733
 011596836 014124127 014124127 014124127 014124127 014124127
 ***   END OF RUN   ***
```

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|------------------------------------------------------------------------------------------------|
|                                                                                                |
|              FETAL RADIATION DOSE TO TOTAL POPULATION = 1.0REM PER INDIVIDUAL: ABSOLUTE RISK     |
|                                                                                                |
|                                        POPULATION AT RISK: GENERAL                             |
|  NUMBER OF DOSE RATES: ONE                                  REFERENCE TABLE INPUT SOURCE: DISK   |
|  RADIATION RISK MODEL: ABSOLUTE                         ADDITIONAL ANALYSIS: STAGES & CANCERS    |
|      ADDITIONAL RISK: NONE                                  ADDITIONAL OUTPUT: LIFE TABLE       |
|------------------------------------------------------------------------------------------------|
|             ***   INPUT DATA   ***                 |              ***   OUTPUT DATA   ***       |
|                                                     |                                           |
|      DOSE                          AGE INTERVAL     |                                           |
|       1.000000000                    -1 -   0       |                                           |
|    CHILD AGE INTERVAL =               0 -   0       |  NUMBER OF PREMATURE DEATHS =                        48.88799 |
|    ADULT AGE INTERVAL =               0 - 110       |  DECREASE IN POPULATION LIFE EXPECTANCY =             0.03292 |
|    OUTPUT DATA BASED ON AGE INTERVAL = 0 - 110      |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =    3292.04687 |
|                                                     |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =    67.33856 |
|------------------------------------------------------------------------------------------------|
|                                                                                                |
|   CANCER                        FETAL                        CHILD                        ADULT        |
|                     LATENCY   PLATEAU   DEATH RATE   LATENCY  PLATEAU  DEATH RATE   LATENCY  PLATEAU  DEATH RATE |
|                                                                                                |
|   LEUKEMIA              0        10      25.000        0        0       0.0          0         0      0.0 |
|   ALL OTHER             0        10      25.000        0        0       0.0          0         0      0.0 |
|------------------------------------------------------------------------------------------------|
|                 CANCER                  FETAL        CHILD        ADULT         TOTAL           |
|                                                                                                |
|                 LEUKEMIA               24.44401       0.0          0.0         24.44401          |
|                 ALL OTHER              24.44401       0.0          0.0         24.44401          |
|                 TOTAL                  48.88803       0.0          0.0         48.88803          |
|                                                                                                |
|------------------------------------------------------------------------------------------------|
|                 TOTAL NUMBER OF INCREMENTAL DEATHS                             48.88799         |
|------------------------------------------------------------------------------------------------|
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GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
0- 1	0.0200195045	0.0000494982	0.0200690028	100000.0000	2006.9003	98996.5499	7072355.4529	70.723555	4.9498
1- 2	0.0012448919	0.0000499676	0.0012948595	97993.0997	126.8873	97929.6561	6973358.9030	71.161734	4.8965
2- 3	0.0008582076	0.0000499773	0.0009081648	97866.2124	88.8806	97821.7721	6875429.2469	70.253350	4.8911
3- 4	0.0006953356	0.0000499813	0.0007453170	97777.3318	72.8751	97740.8943	6777607.4748	69.316756	4.8870
4- 5	0.0005730277	0.0000499844	0.0006230121	97704.4567	60.8711	97674.0212	6679866.5805	68.368085	4.8837
5- 6	0.0005016875	0.0000499862	0.0005516736	97643.5857	53.8674	97616.6520	6582192.5593	67.410394	4.8808
6- 7	0.0004712082	0.0000499869	0.0005211952	97589.7183	50.8633	97564.2866	6484575.9074	66.447327	4.8782
7- 8	0.0004304362	0.0000499880	0.0004804242	97538.8550	46.8600	97515.4250	6387011.6208	65.481716	4.8758
8- 9	0.0003793575	0.0000499892	0.0004293466	97491.9949	41.8579	97471.0660	6289496.1958	64.512950	4.8736
9- 10	0.0003487303	0.0000499900	0.0003987203	97450.1371	38.8553	97430.7094	6192025.1298	63.540446	4.8715
10- 11	0.0003078190	0.0	0.0003078190	97411.2817	29.9850	97396.2892	6094594.4204	62.565591	0.0
11- 12	0.0002976500	0.0	0.0002976500	97381.2967	28.9855	97366.8039	5997198.1312	61.584702	0.0
12- 13	0.0003490720	0.0	0.0003490720	97352.3111	33.9830	97335.3197	5899831.3273	60.602889	0.0
13- 14	0.0004621690	0.0	0.0004621690	97318.3282	44.9775	97295.8394	5802496.0076	59.623877	0.0
14- 15	0.0006267850	0.0	0.0006267850	97273.3507	60.9695	97242.8659	5705200.1682	58.651215	0.0
15- 16	0.0008225290	0.0	0.0008225290	97212.3812	79.9600	97172.4012	5607957.3022	57.687686	0.0
16- 17	0.0010084280	0.0	0.0010084280	97132.4212	97.9511	97083.4457	5510784.9011	56.734763	0.0
17- 18	0.0011639520	0.0	0.0011639520	97034.4701	112.9435	96977.9984	5413701.4554	55.791529	0.0
18- 19	0.0012787460	0.0	0.0012787460	96921.5267	123.9380	96859.5577	5316723.4570	54.855961	0.0
19- 20	0.0013423370	0.0	0.0013423370	96797.5887	129.9350	96732.6212	5219863.8994	53.925557	0.0
20- 21	0.0014061790	0.0	0.0014061790	96667.6537	135.9320	96599.6877	5123131.2782	52.997369	0.0
21- 22	0.0014702840	0.0	0.0014702840	96531.7216	141.9290	96460.7571	5026531.5905	52.071293	0.0
22- 23	0.0015139260	0.0	0.0015139260	96389.7926	145.9270	96316.8291	4930070.8334	51.147229	0.0
23- 24	0.0015266070	0.0	0.0015266070	96243.8656	146.9266	96170.4023	4833754.0043	50.224022	0.0
24- 25	0.0015081390	0.0	0.0015081390	96096.9390	144.9275	96024.4753	4737583.6020	49.300047	0.0
25- 26	0.0014687500	0.0	0.0014687500	95952.0115	140.9295	95881.5467	4641559.1268	48.373755	0.0
26- 27	0.0014396140	0.0	0.0014396140	95811.0820	137.9310	95742.1165	4545677.5801	47.444173	0.0
27- 28	0.0014103490	0.0	0.0014103490	95673.1510	134.9325	95605.6847	4449935.4636	46.511852	0.0
28- 29	0.0014437260	0.0	0.0014437260	95538.2185	137.9310	95469.2530	4354329.7789	45.576837	0.0
29- 30	0.0014772440	0.0	0.0014772440	95400.2874	140.9295	95329.8227	4258860.5259	44.642009	0.0
30- 31	0.0015633690	0.0	0.0015633690	95259.3579	148.9255	95184.8952	4163530.7032	43.707314	0.0
31- 32	0.0016288700	0.0	0.0016288700	95110.4324	154.9225	95032.9712	4068345.8080	42.774969	0.0
32- 33	0.0017157350	0.0	0.0017157350	94955.5099	162.9185	94874.0506	3973312.8369	41.843942	0.0
33- 34	0.0018346690	0.0	0.0018346690	94792.5914	173.9130	94705.6349	3878438.7862	40.914999	0.0
34- 35	0.0019436760	0.0	0.0019436760	94618.6784	183.9081	94526.7243	3783733.1513	39.989283	0.0
35- 36	0.0020850530	0.0	0.0020850530	94434.7703	196.9015	94336.3196	3689206.4270	39.066187	0.0
36- 37	0.0022485020	0.0	0.0022485020	94237.8688	211.8940	94131.9218	3594870.1074	38.146768	0.0
37- 38	0.0024449100	0.0	0.0024449100	94025.9748	229.8850	93911.0323	3500738.1857	37.231607	0.0
38- 39	0.0026640240	0.0	0.0026640240	93796.0697	249.8750	93671.1522	3406827.1534	36.321633	0.0
39- 40	0.0028955160	0.0	0.0028955160	93546.2147	270.8646	93410.7824	3313156.0012	35.417318	0.0

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
40- 41	0.0031503820	0.0	0.0031503820	93275.3501	293.8530	93128.4236	3219745.2188	34.518715	0.0
41- 42	0.0033968270	0.0	0.0033968270	92981.4971	315.8421	92823.5761	3126616.7951	33.626226	0.0
42- 43	0.0037104150	0.0	0.0037104150	92665.6551	343.8280	92493.7411	3033793.2190	32.739133	0.0
43- 44	0.0040381950	0.0	0.0040381950	92321.8271	372.8135	92135.4203	2941299.4779	31.859199	0.0
44- 45	0.0044350240	0.0	0.0044350240	91949.0135	407.7961	91745.1155	2849164.0577	30.986347	0.0
45- 46	0.0048369310	0.0	0.0048369310	91541.2174	442.7786	91319.8282	2757418.9422	30.122157	0.0
46- 47	0.0052883350	0.0	0.0052883350	91098.4389	481.7591	90857.5593	2666099.1140	29.266134	0.0
47- 48	0.0057355890	0.0	0.0057355890	90616.6798	519.7400	90356.8098	2575241.5547	28.419068	0.0
48- 49	0.0062457010	0.0	0.0062457010	90096.9398	562.7185	89815.5805	2484884.7449	27.580124	0.0
49- 50	0.0067761420	0.0	0.0067761420	89534.2212	606.6966	89230.8729	2395069.1644	26.750321	0.0
50- 51	0.0073843460	0.0	0.0073843460	88927.5246	656.6716	88599.1888	2305838.2914	25.929411	0.0
51- 52	0.0080394040	0.0	0.0080394040	88270.8530	709.6450	87916.0305	2217239.1026	25.118587	0.0
52- 53	0.0087552080	0.0	0.0087552080	87561.2080	766.6166	87177.8997	2129323.0721	24.318110	0.0
53- 54	0.0095695430	0.0	0.0095695430	86794.5914	830.5846	86379.2991	2042145.1724	23.528484	0.0
54- 55	0.0104293840	0.0	0.0104293840	85964.0068	896.5516	85515.7310	1955765.8733	22.750986	0.0
55- 56	0.0113735170	0.0	0.0113735170	85067.4552	967.5161	84583.6971	1870250.1423	21.985495	0.0
56- 57	0.0123481730	0.0	0.0123481730	84099.9390	1038.4806	83580.6987	1785666.4452	21.232672	0.0
57- 58	0.0134170850	0.0	0.0134170850	83061.4584	1114.4426	82504.2371	1702085.7465	20.491884	0.0
58- 59	0.0145143190	0.0	0.0145143190	81947.0158	1189.4051	81352.3132	1619581.5094	19.763764	0.0
59- 60	0.0157058340	0.0	0.0157058340	80757.6107	1268.3656	80123.4278	1538229.1961	19.047483	0.0
60- 61	0.0169497920	0.0	0.0169497920	79489.2450	1347.3262	78815.5819	1458105.7683	18.343435	0.0
61- 62	0.0182908890	0.0	0.0182908890	78141.9189	1429.2852	77427.2763	1379290.1863	17.651092	0.0
62- 63	0.0197391560	0.0	0.0197391560	76712.6337	1514.2426	75955.5124	1301862.9101	16.970645	0.0
63- 64	0.0213328730	0.0	0.0213328730	75198.3911	1604.1977	74396.2922	1225907.3977	16.302309	0.0
64- 65	0.0230609390	0.0	0.0230609390	73594.1933	1697.1512	72745.6177	1151511.1055	15.646766	0.0
65- 66	0.0249398750	0.0	0.0249398750	71897.0421	1793.1032	71000.4905	1078765.4878	15.004310	0.0
66- 67	0.0269892640	0.0	0.0269892640	70103.9389	1892.0537	69157.9120	1007764.9973	14.375298	0.0
67- 68	0.0291885240	0.0	0.0291885240	68211.8852	1991.0042	67216.3830	938607.0852	13.760169	0.0
68- 69	0.0315150780	0.0	0.0315150780	66220.8809	2086.9562	65177.4028	871390.7022	13.158851	0.0
69- 70	0.0340055480	0.0	0.0340055480	64133.9247	2180.9093	63043.4701	806213.2994	12.570778	0.0
70- 71	0.0366062210	0.0	0.0366062210	61953.0154	2267.8658	60819.0826	743169.8293	11.995701	0.0
71- 72	0.0394373270	0.0	0.0394373270	59685.1497	2353.8228	58508.2383	682350.7468	11.432505	0.0
72- 73	0.0426603900	0.0	0.0426603900	57331.3269	2445.7768	56108.4385	623842.5085	10.881355	0.0
73- 74	0.0464370910	0.0	0.0464370910	54885.5501	2548.7253	53611.1875	567734.0700	10.343962	0.0
74- 75	0.0507610340	0.0	0.0507610340	52336.8248	2656.6713	51008.4892	514122.8825	9.823349	0.0
75- 76	0.0555074940	0.0	0.0555074940	49680.1535	2757.6208	48301.3431	463114.3933	9.321920	0.0
76- 77	0.0606015420	0.0	0.0606015420	46922.5327	2843.5778	45500.7438	414813.0502	8.840381	0.0
77- 78	0.0659622230	0.0	0.0659622230	44078.9548	2907.5458	42625.1819	369312.3064	8.378427	0.0
78- 79	0.0715430180	0.0	0.0715430180	41171.4090	2945.5269	39698.6456	326687.1245	7.934806	0.0
79- 80	0.0773957380	0.0	0.0773957380	38225.8821	2958.5204	36746.6220	286988.4790	7.507701	0.0

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
80- 81	0.0839450190	0.0	0.0839450190	35267.3618	2960.5194	33787.1021	250241.8570	7.095565	0.0
81- 82	0.0912044050	0.0	0.0912044050	32306.8424	2946.5263	30833.5793	216454.7549	6.699966	0.0
82- 83	0.0989276600	0.0	0.0989276600	29360.3161	2904.5474	27908.0424	185621.1756	6.322179	0.0
83- 84	0.1069553060	0.0	0.1069553060	26455.7687	2829.5848	25040.9763	157713.1332	5.961389	0.0
84- 85	0.1154920040	0.0	0.1154920040	23626.1839	2728.6353	22261.8662	132672.1569	5.615471	0.0
85- 86	0.1255978570	0.0	0.1255978570	20897.5486	2624.6873	19585.2049	110410.2907	5.283409	0.0
86- 87	0.1374576090	0.0	0.1374576090	18272.8612	2511.7438	17016.9893	90825.0858	4.970491	0.0
87- 88	0.1497875580	0.0	0.1497875580	15761.1174	2360.8193	14580.7078	73808.0965	4.682923	0.0
88- 89	0.1616319830	0.0	0.1616319830	13400.2981	2165.9168	12317.3398	59227.3887	4.419856	0.0
89- 90	0.1728647690	0.0	0.1728647690	11234.3814	1942.0287	10263.3670	46910.0489	4.175579	0.0
90- 91	0.1850059160	0.0	0.1850059160	9292.3526	1719.1402	8432.7825	36646.6819	3.943746	0.0
91- 92	0.1988913820	0.0	0.1988913820	7573.2124	1506.2467	6820.0891	28213.8994	3.725486	0.0
92- 93	0.2136738060	0.0	0.2136738060	6066.9657	1296.3517	5418.7899	21393.8103	3.526278	0.0
93- 94	0.2285774150	0.0	0.2285774150	4770.6141	1090.4546	4225.3868	15975.0204	3.348630	0.0
94- 95	0.2433460080	0.0	0.2433460080	3680.1594	895.5521	3232.3834	11749.6337	3.192697	0.0
95- 96	0.2577171570	0.0	0.2577171570	2784.6073	717.6411	2425.7868	8517.2503	3.058690	0.0
96- 97	0.2693423600	0.0	0.2693423600	2066.9662	556.7216	1788.6055	6091.4635	2.947055	0.0
97- 98	0.2806088680	0.0	C.2806088680	1510.2447	423.7881	1298.3507	4302.8580	2.849113	0.0
98- 99	0.2897884080	0.0	0.2897884080	1086.4566	314.8425	929.0354	3004.5074	2.765419	0.0
99-100	0.2979274610	0.0	0.2979274610	771.6141	229.8850	656.6716	2075.4720	2.689780	0.0
100-101	0.3081180810	0.0	0.3081180810	541.7291	166.9165	458.2708	1418.8004	2.619022	0.0
101-102	0.3146666670	C.0	0.3146666670	374.8125	117.9410	315.8420	960.5296	2.562693	0.0
102-103	0.3190661480	0.0	C.3190661480	256.8715	81.9590	215.8920	644.6876	2.509767	0.0
103-104	0.3314285710	0.0	0.3314285710	174.9125	57.9710	145.9270	428.7955	2.451486	0.0
104-105	0.3333333330	C.0	0.3333333330	116.9415	38.9805	97.4513	282.8685	2.418889	0.0
105-106	0.3333333330	0.0	0.3333333330	77.9610	25.9870	64.9675	185.4173	2.378333	0.0
106-107	0.3461538460	0.0	0.3461538460	51.9740	17.9910	42.9785	120.4498	2.317500	0.0
107-108	0.3529411760	0.0	0.3529411760	33.9830	11.9940	27.9860	77.4713	2.279706	0.0
108-109	0.3636363640	0.0	0.3636363640	21.9890	7.9960	17.9910	49.4853	2.250455	0.0
109-110	0.3571428570	0.0	0.3571428570	13.9930	4.9975	11.4943	31.4943	2.250714	0.0

FETAL RADIATION DOSE TO TOTAL POPULATION = 1.0REM PER INDIVIDUAL: RELATIVE RISK

```
|------------------------------------------------------------------------------------------------------------------------|
|                  FETAL RADIATION DOSE TO TOTAL POPULATION = 1.0REM PER INDIVIDUAL: RELATIVE RISK                       |
|                                                                                                                        |
|   NUMBER OF DOSE RATES: ONE                       POPULATION AT RISK: GENERAL                                          |
|   RADIATION RISK MODEL: RELATIVE                                      REFERENCE TABLE INPUT SOURCE: DISK               |
|       ADDITIONAL RISK: NONE                                                  ADDITIONAL ANALYSIS: STAGES & CANCERS     |
|                                                                                ADDITIONAL OUTPUT: LIFE TABLE           |
|------------------------------------------------------------------------------------------------------------------------|
|                   ***   INPUT DATA   ***                        |                                                      |
|                                                                 |               ***   OUTPUT DATA   ***                |
|        DOSE                              AGE INTERVAL           |                                                      |
|          1.000000000                       -1 -   0             |                                                      |
|      CHILD AGE INTERVAL =                   0 -   0             |  NUMBER OF PREMATURE DEATHS =                 33.40181 |
|      ADULT AGE INTERVAL =                   0 - 110             |  DECREASE IN POPULATION LIFE EXPECTANCY =      0.02249 |
|      OUTPUT DATA BASED ON AGE INTERVAL =    0 - 110             |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 2249.10962 |
|                                                                 |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 67.33496 |
|------------------------------------------------------------------------------------------------------------------------|
|   CANCER                                                                                                               |
|                              FETAL                              CHILD                             ADULT               |
|                     LATENCY PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE   |
|   LEUKEMIA              0      10      0.500             0        0        0.0             0        0        0.0      |
|   ALL OTHER             0      10      0.500             0        0        0.0             0        0        0.0      |
|------------------------------------------------------------------------------------------------------------------------|
|                  CANCER                       FETAL         CHILD         ADULT           TOTAL                       |
|                                                                                                                        |
|                  LEUKEMIA                    16.38830        0.0           0.0          16.38830                      |
|                  ALL OTHER                   17.01355        0.0           0.0          17.01355                      |
|                  TOTAL                       33.40185        0.0           0.0          33.40185                      |
|------------------------------------------------------------------------------------------------------------------------|
|                  TOTAL NUMBER OF INCREMENTAL DEATHS                                       33.40181                    |
|------------------------------------------------------------------------------------------------------------------------|
```

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
0- 1	0.0200196620	0.0000337655	0.0200534275	100000.0000	2005.3428	98997.3286	7073398.3900	70.733984	3.3766
1- 2	0.0012449018	0.0000340857	0.0012789875	97994.6572	125.3339	97931.9903	6974401.0614	71.171238	3.3402
2- 3	0.0008582144	0.0000340923	0.0008923067	97869.32 3	87.3294	97825.6586	6876469.0711	70.261741	3.3366
3- 4	0.0006953411	0.0000340951	0.0007294362	97781.9939	71.3257	97746.3310	6778643.4125	69.324046	3.3339
4- 5	0.0005730322	0.0000340971	0.0006071294	97710.6681	59.3230	97681.0066	6680897.0815	68.374285	3.3317
5- 6	0.0005016914	0.0000342013	0.0005358928	97651.3451	52.3306	97625.1798	6583216.0749	67.415519	3.3398
6- 7	0.0004712119	0.0000342019	0.0005054138	97599.0145	49.3279	97574.3505	6485590.8951	66.451397	3.3381
7- 8	0.0004304396	0.0000342026	0.0004646422	97549.6866	45.3257	97527.0237	6388016.5446	65.484747	3.3364
8- 9	0.0003793605	0.0000342034	0.0004135639	97504.3609	40.3243	97484.1987	6290489.5208	64.514956	3.3350
9- 10	0.0003487330	0.0000342039	0.0003829370	97464.0366	37.3226	97445.3753	6193005.3221	63.541441	3.3337
10- 11	0.0003078190	0.0	0.0003078190	97426.7140	29.9898	97411.7191	6095559.9468	62.565591	0.0
11- 12	0.0002976500	0.0	0.0002976500	97396.7242	28.9901	97382.2291	5998148.2277	61.584702	0.0
12- 13	0.0003490720	0.0	0.0003490720	97367.7341	33.9883	97350.7399	5900765.9986	60.602889	0.0
13- 14	0.0004621690	0.0	0.0004621690	97333.7457	44.9846	97311.2534	5803415.2586	59.623877	0.0
14- 15	0.0006267850	0.0	0.0006267850	97288.7611	60.9791	97258.2715	5706104.0052	58.651215	0.0
15- 16	0.0008225290	0.0	0.0008225290	97227.7820	79.9727	97187.7956	5608845.7337	57.687686	0.0
16- 17	0.0010084280	0.0	0.0010084280	97147.8093	97.9666	97098.8260	5511657.9381	56.734763	0.0
17- 18	0.0011639520	0.0	0.0011639520	97049.8427	112.9614	96993.3620	5414559.1121	55.791529	0.0
18- 19	0.0012787460	0.0	0.0012787460	96936.8814	123.9576	96874.9025	5317565.7501	54.855961	0.0
19- 20	0.0013423370	0.0	0.0013423370	96812.9237	129.9556	96747.9459	5220690.8475	53.925557	0.0
20- 21	0.0014061790	0.0	0.0014061790	96682.9681	135.9536	96614.9914	5123942.9016	52.997369	0.0
21- 22	0.0014702840	0.0	0.0014702840	96547.0146	141.9515	96476.0388	5027327.9103	52.071293	0.0
22- 23	0.0015139260	0.0	0.0015139260	96405.0630	145.9501	96332.0880	4930851.8714	51.147229	0.0
23- 24	0.0015266070	0.0	0.0015266070	96259.1129	146.9498	96185.6360	4834519.7835	50.224022	0.0
24- 25	0.0015081390	0.0	0.0015081390	96112.1631	144.9505	96039.6878	4738334.1455	49.300047	0.0
25- 26	0.0014687500	0.0	0.0014687500	95967.2126	140.9518	95896.7367	4642294.4576	48.373755	0.0
26- 27	0.0014396140	0.0	0.0014396140	95826.2607	137.9528	95757.2843	4546397.7210	47.444173	0.0
27- 28	0.0014103490	0.0	0.0014103490	95688.3079	134.9539	95620.8310	4450640.4367	46.511852	0.0
28- 29	0.0014437260	0.0	0.0014437260	95553.3540	137.9529	95484.3776	4355019.6057	45.576837	0.0
29- 30	0.0014772440	0.0	0.0014772440	95415.4011	140.9518	95344.9252	4259535.2282	44.642009	0.0
30- 31	0.0015633690	0.0	0.0015633690	95274.4493	148.9491	95199.9747	4164190.3029	43.707314	0.0
31- 32	0.0016288700	0.0	0.0016288700	95125.5002	154.9471	95048.0266	4068990.3282	42.774969	0.0
32- 33	0.0017157350	0.0	0.0017157350	94970.5531	162.9443	94889.0810	3973942.3015	41.843942	0.0
33- 34	0.0018346690	0.0	0.0018346690	94807.6088	173.9406	94720.6385	3879053.2206	40.914999	0.0
34- 35	0.0019436760	0.0	0.0019436760	94633.6682	183.9372	94541.6996	3784332.5821	39.989283	0.0
35- 36	0.0020850530	0.0	0.0020850530	94449.7310	196.9327	94351.2647	3689790.8824	39.066187	0.0
36- 37	0.0022485020	0.0	0.0022485020	94252.7983	211.9276	94146.8345	3595439.6177	38.146768	0.0
37- 38	0.0024449100	0.0	0.0024449100	94040.8707	229.9215	93925.9100	3501292.7832	37.231607	0.0
38- 39	0.0026640240	0.0	0.0026640240	93810.9493	249.9146	93685.9920	3407366.8732	36.321633	0.0
39- 40	0.0028955160	0.0	0.0028955160	93561.0347	270.9075	93425.5809	3313680.8812	35.417318	0.0

GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
40- 41	0.0031503820	0.0	0.0031503820	93290.1272	293.8995	93143.1774	3220255.3003	34.518715	0.0
41- 42	0.0033968270	0.0	0.0033968270	92996.2276	315.8921	92838.2816	3127112.1229	33.626226	0.0
42- 43	0.0037104150	0.0	0.0037104150	92680.3355	343.8825	92508.3943	3034273.8413	32.739133	0.0
43- 44	0.0040381950	0.0	0.0040381950	92336.4530	372.8726	92150.0167	2941765.4470	31.859199	0.0
44- 45	0.0044350240	0.0	0.0044350240	91963.5804	407.8607	91759.6501	2849615.4303	30.986347	0.0
45- 46	0.0048369310	0.0	0.0048369310	91555.7198	442.8487	91334.2954	2757855.7802	30.122157	0.0
46- 47	0.0052883350	0.0	0.0052883350	91112.8711	481.8354	90871.9534	2666521.4848	29.266134	0.0
47- 48	0.0057355890	0.0	0.0057355890	90631.0357	519.8224	90371.1245	2575649.5314	28.419068	0.0
48- 49	0.0062457010	0.0	0.0062457010	90111.2133	562.8077	89829.8094	2485278.4069	27.580124	0.0
49- 50	0.0067761420	0.0	0.0067761420	89548.4056	606.7927	89245.0092	2395448.5975	26.750321	0.0
50- 51	0.0073843460	0.0	0.0073843460	88941.6129	656.7756	88613.2251	2306203.5882	25.929410	0.0
51- 52	0.0080394040	0.0	0.0080394040	88284.8372	709.7575	87929.9585	2217590.3632	25.118587	0.0
52- 53	0.0087552080	0.0	0.0087552080	67575.0798	766.7380	87191.7108	2129660.4047	24.318110	0.0
53- 54	0.0095695430	0.0	0.0095695430	86808.3417	830.7162	86392.9837	2042468.6939	23.528484	0.0
54- 55	0.0104293840	0.0	0.0104293840	85977.6256	896.6937	85529.2787	1956075.7103	22.750985	0.0
55- 56	0.0113735170	0.0	0.0113735170	65080.9319	967.6694	84597.0972	1870546.4315	21.985495	0.0
56- 57	0.0123481730	0.0	0.0123481730	84113.2625	1038.6451	83593.9399	1785949.3343	21.232672	0.0
57- 58	0.0134170850	0.0	0.0134170850	83074.6174	1114.6192	82517.3078	1702355.3944	20.491884	0.0
58- 59	0.0145143190	0.0	0.0145143190	81959.9982	1189.5936	81365.2014	1619838.0867	19.763764	0.0
59- 60	0.0157058340	0.0	0.0157058340	80770.4046	1268.5666	80136.1213	1538472.8853	19.047483	0.0
60- 61	0.0169497920	0.0	0.0169497920	79501.8380	1347.5396	78828.0682	1458336.7640	18.343435	0.0
61- 62	0.0182908890	0.0	0.0182908890	78154.2984	1429.5116	77439.5426	1379508.6957	17.651092	0.0
62- 63	0.0197391560	0.0	0.0197391560	76724.7868	1514.4825	75967.5455	1302069.1531	16.970645	0.0
63- 64	0.0213328730	0.0	0.0213328730	75210.3043	1604.4519	74408.0783	1226101.6076	16.302309	0.0
64- 65	0.0230609390	0.0	0.0230609390	73605.8524	1697.4201	72757.1424	1151693.5292	15.646766	0.0
65- 66	0.0249398750	0.0	0.0249398750	71908.4323	1793.3873	71011.7367	1078936.3869	15.004310	0.0
66- 67	0.0269892640	0.0	0.0269892640	70115.0450	1892.3535	69168.8683	1007924.6482	14.375298	0.0
67- 68	0.0291885240	0.0	0.0291885240	68222.6916	1991.3197	67227.0317	938755.7799	13.760169	0.0
68- 69	0.0315150780	0.0	0.0315150780	66231.3719	2087.2869	65187.7285	871528.7482	13.158851	0.0
69- 70	0.0340055480	0.0	0.0340055480	64144.0850	2181.2548	63053.4577	806341.0197	12.570777	0.0
70- 71	0.0366062210	0.0	0.0366062210	61962.8303	2268.2251	60828.7177	743287.5620	11.995701	0.0
71- 72	0.0394373270	0.0	0.0394373270	59694.6052	2354.1957	58517.5074	682458.8443	11.432505	0.0
72- 73	0.0426603900	0.0	0.0426603900	57340.4096	2446.1642	56117.3274	623941.3369	10.881355	0.0
73- 74	0.0464370910	0.0	0.0464370910	54894.2453	2549.1291	53619.6808	567824.0095	10.343962	0.0
74- 75	0.0507610340	0.0	0.0507610340	52345.1163	2657.0922	51016.5701	514204.3287	9.823349	0.0
75- 76	0.0555074940	0.0	0.0555074940	49688.0240	2758.0577	48308.9952	463187.7585	9.321919	0.0
76- 77	0.0606015420	0.0	0.0606015420	46929.9663	2844.0283	45507.9522	414878.7634	8.840381	0.0
77- 78	0.0659622230	0.0	0.0659622230	44085.9380	2908.0065	42631.9348	369370.8112	8.378427	0.0
78- 79	0.0715430180	0.0	0.0715430180	41177.9315	2945.9935	39704.9348	326738.8764	7.934805	0.0
79- 80	0.0773957380	0.0	0.0773957380	38231.9380	2958.9891	36752.4435	287033.9416	7.507701	0.0

```
|-----------------------------------------------------------------------------------------------------------------------------|
|                         GENERATED LIFE TABLE FOR THE GENERAL POPULATION: UNITED STATES, 1969-71                             |
|-----------------------------------------------------------------------------------------------------------------------------|
|          |              |              |              |            |           |            |             |          |        |
|X TO X+T  |     TQX      |     IXR      |     TQXR     |    LXR     |    DXR    |    TLXR    |     TXR     |   EXR    | IXRLXR |
|          |              |              |              |            |           |            |             |          |        |
|-----------------------------------------------------------------------------------------------------------------------------|
|          |              |              |              |            |           |            |             |          |        |
| YEARS    |              |              |              |            |           |            |             |          |        |
|          |              |              |              |            |           |            |             |          |        |
|  80- 81  | 0.0839450190 | 0.0          | 0.0839450190 | 35272.9490 | 2960.9884 | 33792.4548 | 250281.4981 | 7.095565 |  0.0   |
|  81- 82  | 0.0912044050 | 0.0          | 0.0912044050 | 32311.9606 | 2946.9931 | 30838.4640 | 216489.0433 | 6.699966 |  0.0   |
|  82- 83  | 0.0989276600 | 0.0          | 0.0989276600 | 29364.9675 | 2905.0075 | 27912.4637 | 185650.5793 | 6.322179 |  0.0   |
|  83- 84  | 0.1069553060 | 0.0          | 0.1069553060 | 26459.9599 | 2830.0331 | 25044.9434 | 157738.1156 | 5.961389 |  0.0   |
|  84- 85  | 0.1154920040 | 0.0          | 0.1154920040 | 23629.9268 | 2729.0676 | 22265.3930 | 132693.1722 | 5.615471 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
|  85- 86  | 0.1255978570 | 0.0          | 0.1255978570 | 20900.8592 | 2625.1031 | 19588.3077 | 110427.7792 | 5.283409 |  0.0   |
|  86- 87  | 0.1374576090 | 0.0          | 0.1374576090 | 18275.7561 | 2512.1417 | 17019.6852 |  90839.4715 | 4.970490 |  0.0   |
|  87- 88  | 0.1497875580 | 0.0          | 0.1497875580 | 15763.6144 | 2361.1933 | 14583.0177 |  73819.7863 | 4.682923 |  0.0   |
|  88- 89  | 0.1616319830 | 0.0          | 0.1616319830 | 13402.4211 | 2166.2599 | 12319.2911 |  59236.7686 | 4.419856 |  0.0   |
|  89- 90  | 0.1728647690 | 0.0          | 0.1728647690 | 11236.1612 | 1942.3364 | 10264.9930 |  46917.4775 | 4.175579 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
|  90- 91  | 0.1850059160 | 0.0          | 0.1850059160 |  9293.8248 | 1719.4126 |  8434.1185 |  36652.4845 | 3.943746 |  0.0   |
|  91- 92  | 0.1988913820 | 0.0          | 0.1988913820 |  7574.4122 | 1506.4853 |  6821.1695 |  28218.3660 | 3.725486 |  0.0   |
|  92- 93  | 0.2136738060 | 0.0          | 0.2136738060 |  6067.9269 | 1296.5570 |  5419.6484 |  21397.1965 | 3.526278 |  0.0   |
|  93- 94  | 0.2285774150 | 0.0          | 0.2285774150 |  4771.3699 | 1090.6274 |  4226.0562 |  15977.5481 | 3.348629 |  0.0   |
|  94- 95  | 0.2433460080 | 0.0          | 0.2433460080 |  3680.7425 |  895.6940 |  3232.8955 |  11751.4919 | 3.192696 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
|  95- 96  | 0.2577171570 | 0.0          | 0.2577171570 |  2785.0485 |  717.7548 |  2426.1711 |   8518.5964 | 3.058689 |  0.0   |
|  96- 97  | 0.2693423600 | 0.0          | 0.2693423600 |  2067.2937 |  556.8098 |  1788.8888 |   6092.4253 | 2.947054 |  0.0   |
|  97- 98  | 0.2806088680 | 0.0          | 0.2806088680 |  1510.4839 |  423.6552 |  1298.5563 |   4303.5365 | 2.849111 |  0.0   |
|  98- 99  | 0.2897884080 | 0.0          | 0.2897884080 |  1086.6286 |  314.8924 |   929.1825 |   3004.9802 | 2.765416 |  0.0   |
|  99-100  | 0.2979274610 | 0.0          | 0.2979274610 |   771.7363 |  229.9214 |   656.7756 |   2075.7976 | 2.689776 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
| 100-101  | 0.3081180810 | 0.0          | 0.3081180810 |   541.8149 |  166.9430 |   458.3434 |   1419.0220 | 2.619016 |  0.0   |
| 101-102  | 0.3146666670 | 0.0          | 0.3146666670 |   374.8719 |  117.9597 |   315.8921 |    960.6786 | 2.562685 |  0.0   |
| 102-103  | 0.3190661480 | 0.0          | 0.3190661480 |   256.9122 |   81.9720 |   215.9262 |    644.7865 | 2.509754 |  0.0   |
| 103-104  | 0.3314285710 | 0.0          | 0.3314285710 |   174.9402 |   57.9802 |   145.9501 |    428.8603 | 2.451468 |  0.0   |
| 104-105  | 0.3333333330 | 0.0          | 0.3333333330 |   116.9600 |   38.9867 |    97.4667 |    282.9102 | 2.418862 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
| 105-106  | 0.3333333330 | 0.0          | 0.3333333330 |    77.9734 |   25.9911 |    64.9778 |    185.4435 | 2.378293 |  0.0   |
| 106-107  | 0.3461538460 | 0.0          | 0.3461538460 |    51.9822 |   17.9939 |    42.9853 |    120.4657 | 2.317439 |  0.0   |
| 107-108  | 0.3529411760 | 0.0          | 0.3529411760 |    33.9884 |   11.9959 |    27.9904 |     77.4804 | 2.279613 |  0.0   |
| 108-109  | 0.3636363640 | 0.0          | 0.3636363640 |    21.9925 |    7.9973 |    17.9939 |     49.4899 | 2.250311 |  0.0   |
| 109-110  | 0.3571428570 | 0.0          | 0.3571428570 |    13.9952 |    4.9983 |    11.4961 |     31.4961 | 2.250488 |  0.0   |
|          |              |              |              |            |           |            |             |          |        |
|-----------------------------------------------------------------------------------------------------------------------------|
|-----------------------------------------------------------------------------------------------------------------------------|
***    END OF RUN    ***
```

Sample Problem 3.

This problem addresses the adult stage radiation exposure discussed in section 4.3b. The four cases analyzed examine the effects of absolute and relative risk, and 30 and life plateau periods on the adult exposure.

The title and case data for the first absolute risk case are input followed by the two cancer data cards. Since the second case differs only by the all other cancer plateau period, there is no need to input the case data again. Setting CASREP equal to 2 on the all other cancer card causes the cancer cards for the second case to be input. These are used with the retained case data to generate the second case results.

Since CASREP is 1 on the second case's all other cancer card (if there is more than one cancer card, the CASREP value on the last card is used), new case data are input. Use of CANREP allows cancer mortality data to be input and retained for subsequent relative risk cases.

Only summary tables are output for these cases.

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, ABSOLUTE RISK
3121411       2   10   20   20    0    0    0    0    0    0    0    0
   30    0    0    0    0    0    0    0    0       1.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
12  1     LEUKEMIA            0    0 0.0    0    0 0.0    2   25 1.0
22  2     ALL OTHER           0    0 0.0    0    0 0.0   15   30 5.0
12  1     LEUKEMIA            0    0 0.0    0    0 0.0    2   25 1.0
12  2     ALL OTHER           0    0 0.0    0    0 0.0   15  110 5.0
ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, RELATIVE RISK
3131411       2   10   20   20    0    0    0    0    0    0    0    0
   30    0    0    0    0    0    0    0    0       1.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
11  1     LEUKEMIA            0    0 0.0    0    0 0.0    2   25 0.02
 000031184 000035367 000021347 000020230 000016544 000016845 000021854 000028818
 000035454 000043871 000062375 000100071 000140039 000225118 000348896 000467433
 000590330 000740884 000740884 000740884 000740884 000740884
21  2     ALL OTHER           0    0 0.0    0    0 0.0   15   30 .002
 000037031 000032554 000032216 000052229 000071318 000110858 000196325 000389229
 000758201 001319668 002196321 003419671 004864605 006583333 008509686 010022733
 011596836 014124127 014124127 014124127 014124127 014124127
22  1     LEUKEMIA            0    0 0.0    0    0 0.0    2   25 0.02
12  2     ALL OTHER           0    0 0.0    0    0 0.0   15  110 .002
 ***    END OF RUN    ***
```

```
|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                      |
|                     ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, ABSOLUTE RISK                 |
|                                                                                                                      |
|                                                POPULATION AT RISK: GENERAL                                           |
|    NUMBER OF DOSE RATES: ONE                                               REFERENCE TABLE INPUT SOURCE: DISK        |
|    RADIATION RISK MODEL: ABSOLUTE                                                  ADDITIONAL ANALYSIS: STAGES & CANCERS |
|        ADDITIONAL RISK: NONE                                                        ADDITIONAL OUTPUT: NONE          |
|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
|                                                         |                                                            |
|                  ***   INPUT DATA   ***                 |                 ***   OUTPUT DATA   ***                    |
|                                                         |                                                            |
|          DOSE                              AGE INTERVAL |                                                            |
|           1.000000000                        20 -  30   |                                                            |
|       CHILD AGE INTERVAL =                    0 -  10   |  NUMBER OF PREMATURE DEATHS =                   151.52635  |
|       ADULT AGE INTERVAL =                   10 - 110   |  DECREASE IN POPULATION LIFE EXPECTANCY =          0.03810 |
|       OUTPUT DATA BASED ON AGE INTERVAL =    20 - 110   |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =  3809.50391 |
|                                                         |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =  25.14085 |
|                                                         |                                                            |
|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                      |
|     CANCER                            FETAL                            CHILD                           ADULT        |
|                             LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|                                                                                                                      |
|     LEUKEMIA                    0        0      0.0            0        0       0.0             2        25      1.000  |
|     ALL OTHER                   0        0      0.0            0        0       0.0            15        30      5.000  |
|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                      |
|                    CANCER                      FETAL          CHILD          ADULT             TOTAL                 |
|                                                                                                                      |
|                    LEUKEMIA                      0.0            0.0       23.18555          23.18555                 |
|                    ALL OTHER                     0.0            0.0      123.36495         123.36495                 |
|                    TOTAL                         0.0            0.0      146.55050         146.55050                 |
|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                      |
|                    TOTAL NUMBER OF INCREMENTAL DEATHS                                      151.52635                 |
|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
--------------------------------------------------------------------------------------------------------
|                                                                                                      |
|        ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, ABSOLUTE RISK              |
|                                                                                                      |
|                                  POPULATION AT RISK: GENERAL                                         |
|   NUMBER OF DOSE RATES: ONE                         REFERENCE TABLE INPUT SOURCE: DISK              |
|   RADIATION RISK MODEL: ABSOLUTE                          ADDITIONAL ANALYSIS: STAGES & CANCERS     |
|        ADDITIONAL RISK: NONE                               ADDITIONAL OUTPUT: NONE                   |
|                                                                                                      |
--------------------------------------------------------------------------------------------------------
|                                              |                                                       |
|              ***   INPUT DATA   ***          |              ***   OUTPUT DATA   ***                  |
|                                              |                                                       |
|        DOSE                 AGE INTERVAL     |                                                       |
|         1.000000000           20 -  30       |  NUMBER OF PREMATURE DEATHS =                190.36925 |
|     CHILD AGE INTERVAL =       0 -  10       |  DECREASE IN POPULATION LIFE EXPECTANCY =       0.04137 |
|     ADULT AGE INTERVAL =      10 - 110       |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 4136.90625 |
|     OUTPUT DATA BASED ON AGE INTERVAL = 20 - 110  |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =  21.73096 |
|                                              |                                                       |
--------------------------------------------------------------------------------------------------------
|                                                                                                      |
|   CANCER                     FETAL                         CHILD                          ADULT      |
|                   LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE   LATENCY  PLATEAU  DEATH RATE |
|                                                                                                      |
|   LEUKEMIA             0        0     0.0            0        0      0.0          2       25     1.000 |
|   ALL OTHER            0        0     0.0            0        0      0.0         15      110     5.000 |
|                                                                                                      |
--------------------------------------------------------------------------------------------------------
|                                                                                                      |
|                 CANCER                 FETAL          CHILD          ADULT             TOTAL          |
|                                                                                                      |
|                 LEUKEMIA                 0.0            0.0         23.18555          23.18555        |
|                 ALL OTHER                0.0            0.0        160.93247         160.93247        |
|                 TOTAL                    0.0            0.0        184.11801         184.11801        |
|                                                                                                      |
--------------------------------------------------------------------------------------------------------
|                                                                                                      |
|                 TOTAL NUMBER OF INCREMENTAL DEATHS                              190.36925             |
|                                                                                                      |
--------------------------------------------------------------------------------------------------------
```

```
-------------------------------------------------------------------------------------------------------------
|                                                                                                           |
|                   ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, RELATIVE RISK        |
|                                                                                                           |
|                                           POPULATION AT RISK: GENERAL                                     |
|   NUMBER OF DOSE RATES: ONE                                         REFERENCE TABLE INPUT SOURCE: DISK    |
|   RADIATION RISK MODEL: RELATIVE                                       ADDITIONAL ANALYSIS: STAGES & CANCERS |
|       ADDITIONAL RISK: NONE                                              ADDITIONAL OUTPUT: NONE          |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                   |                                                       |
|               ***   INPUT DATA   ***              |             ***   OUTPUT DATA   ***                   |
|                                                   |                                                       |
|        DOSE                         AGE INTERVAL  |                                                       |
|         1.000000000                   20 -  30    |                                                       |
|      CHILD AGE INTERVAL =              0 -  10    |  NUMBER OF PREMATURE DEATHS =                168.92007 |
|      ADULT AGE INTERVAL =             10 - 110    |  DECREASE IN POPULATION LIFE EXPECTANCY =      0.03384 |
|      OUTPUT DATA BASED ON AGE INTERVAL = 20 - 110 |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 3384.33057 |
|                                                   |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =  20.03510 |
|                                                   |                                                       |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|    CANCER                      FETAL                           CHILD                          ADULT       |
|                       LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|                                                                                                           |
|    LEUKEMIA                0        0     0.0             0        0     0.0              2       25     0.020 |
|    ALL OTHER               0        0     0.0             0        0     0.0             15       30     0.002 |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|                   CANCER                   FETAL          CHILD          ADULT            TOTAL            |
|                                                                                                           |
|                   LEUKEMIA                   0.0            0.0         15.40857         15.40857          |
|                   ALL OTHER                  0.0            0.0        147.96438        147.96438          |
|                   TOTAL                      0.0            0.0        163.37295        163.37295          |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|                   TOTAL NUMBER OF INCREMENTAL DEATHS                                      168.92007        |
|                                                                                                           |
-------------------------------------------------------------------------------------------------------------
```

```
|------------------------------------------------------------------------------------------------------------------------------|
|                      ADULT RADIATION DOSE TO TOTAL POPULATION = 1.0REM/PERSON/AGE20-30, RELATIVE RISK                          |
|                                                                                                                              |
|                                                 POPULATION AT RISK: GENERAL                                                  |
|  NUMBER OF DOSE RATES: ONE                                                     REFERENCE TABLE INPUT SOURCE: DISK            |
|  RADIATION RISK MODEL: RELATIVE                                                         ADDITIONAL ANALYSIS: STAGES & CANCERS |
|      ADDITIONAL RISK: NONE                                                                 ADDITIONAL OUTPUT: NONE            |
|                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------|
|                                                            |                                                                 |
|               ***   INPUT DATA   ***                       |                     ***   OUTPUT DATA   ***                     |
|                                                            |                                                                 |
|         DOSE                            AGE INTERVAL       |                                                                 |
|          1.000000000                     20 -  30          |                                                                 |
|     CHILD AGE INTERVAL =                  0 -  10          |  NUMBER OF PREMATURE DEATHS =                          325.95239 |
|     ADULT AGE INTERVAL =                 10 - 110          |  DECREASE IN POPULATION LIFE EXPECTANCY =                0.04619 |
|     OUTPUT DATA BASED ON AGE INTERVAL =  20 - 110          |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =       4619.00391 |
|                                                            |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =       14.17079 |
|                                                            |                                                                 |
|------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                              |
|    CANCER                             FETAL                                 CHILD                              ADULT          |
|                         LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE     |
|                                                                                                                              |
|    LEUKEMIA                  0        0       0.0               0        0       0.0              2       25      0.020      |
|    ALL OTHER                 0        0       0.0               0        0       0.0             15      110      0.002      |
|                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                              |
|                       CANCER                       FETAL         CHILD          ADULT              TOTAL                      |
|                                                                                                                              |
|                       LEUKEMIA                       0.0           0.0        15.40857           15.40857                     |
|                       ALL OTHER                      0.0           0.0       299.84345          299.84345                     |
|                       TOTAL                          0.0           0.0       315.25202          315.25202                     |
|                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                              |
|                       TOTAL NUMBER OF INCREMENTAL DEATHS                                          325.95239                   |
|                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------|
***   END OF RUN   ***
```

Sample Problem 4.

The last problem considered in the text concerns combining accident and radiation risk and is discussed in section 4.4. In this example, the radiation exposure interval partially overlaps the first of two accident exposure intervals. The effects are calculated using the male population, for which the BEIR absolute risk estimate for all other cancers has been reapportioned to eliminate the risk of death from breast cancer.

Use is made of the code's multiple accident risk provision to accommodate the two different accident exposure intervals and rates. Both radiation and non-radiation risk summaries are provided in the summary table.

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

   TOTAL POPULATION: OCCUPATIONAL EXPOSURE DURING 18 - 65 AGE INTERVAL
3121421       2   10   18   18    0    0    0    0    0    0    0    0
   65    0    0    0    0    0    0    0    0       5.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
22   1    LEUKEMIA            0    0  0.0    2   25  2.0    2   25  1.0
22   2    ALL OTHER           0    0  0.0   15  110  1.0   15  110  5.0
22   1    LEUKEMIA            0    0  0.0    2   25  2.0    2   25  1.0
12   2    ALL OTHER           0    0  0.0   15   30  1.0   15   30  5.0
   TOTAL POPULATION: OCCUPATIONAL EXPOSURE DURING 18 - 65 AGE INTERVAL
3121411       2   10   18   18    0    0    0    0    0    0    0    0
   65    0    0    0    0    0    0    0    0       1.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
22   1    LEUKEMIA            0    0  0.0    2   25  2.0    2   25  1.0
22   2    ALL OTHER           0    0  0.0   15  110  1.0   15  110  5.0
22   1    LEUKEMIA            0    0  0.0    2   25  2.0    2   25  1.0
12   2    ALL OTHER           0    0  0.0   15   30  1.0   15   30  5.0
   TOTAL POPULATION: OCCUPATIONAL EXPOSURE DURING 18 - 65 AGE INTERVAL
3131411       2   10   18   18    0    0    0    0    0    0    0    0
   65    0    0    0    0    0    0    0    0       5.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
21   1    LEUKEMIA            0    0  0.0    2   25 0.05    2   25 0.02
 000031184 000035367 000021347 000020230 000016544 000016845 000021854 000028818
 000035454 000043871 000062375 000100071 000140089 000225118 000348896 000467433
 000590830 000740884 000740884 000740884 000740884 000740884
21   2    ALL OTHER           0    0  0.0   15  110 0.02   15  110 .002
 000037031 000032554 000032216 000052229 000071818 000110858 000196325 000389229
 000758201 001319668 002196321 003419671 004864605 006583333 008509636 010022733
 011596886 014124127 014124127 014124127 014124127 014124127
22   1    LEUKEMIA            0    0  0.0    2   25 0.05    2   25 0.02
12   2    ALL OTHER           0    0  0.0   15   30 0.02   15   30 .002
   TOTAL POPULATION: OCCUPATIONAL EXPOSURE DURING 18 - 65 AGE INTERVAL
3131411       2   10   18   18    0    0    0    0    0    0    0    0
   65    0    0    0    0    0    0    0    0       1.0       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
22   1    LEUKEMIA            0    0  0.0    2   25 0.05    2   25 0.02
22   2    ALL OTHER           0    0  0.0   15  110 0.02   15  110 .002
22   1    LEUKEMIA            0    0  0.0    2   25 0.05    2   25 0.02
12   2    ALL OTHER           0    0  0.0   15   30 0.02   15   30 .002
   ***   END OF  RUN    ***
```

```
|------------------------------------------------------------------------------------------------------|
|                                                                                                      |
|              MALE POP: ACC. RISK=0.0005 FOR 25-35; 0.0002 FOR 35-45; DOSE=3.0REM FOR 20-30           |
|                                                                                                      |
|                                         POPULATION AT RISK: MALE                                     |
|   NUMBER OF DOSE RATES: ONE                                  REFERENCE TABLE INPUT SOURCE: DISK      |
|   RADIATION RISK MODEL: ABSOLUTE                                   ADDITIONAL ANALYSIS: STAGES & CANCERS |
|       ADDITIONAL RISK: ACCIDENT MULTIP LE)                           ADDITIONAL OUTPUT: NONE          |
|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
|                                                 |                                                    |
|               ***   INPUT DATA   ***            |                  ***   OUTPUT DATA   ***           |
|                                                 |                                                    |
|        DOSE                      AGE INTERVAL   |                                                    |
|         3.000000000                20 -  30     |                                                    |
|     CHILD AGE INTERVAL =            0 -  10     |  NUMBER OF PREMATURE DEATHS =                1061.11230 |
|     ADULT AGE INTERVAL =           10 - 110     |  DECREASE IN POPULATION LIFE EXPECTANCY =       0.34428 |
|     OUTPUT DATA BASED ON AGE INTERVAL =  20 - 110  |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =  34428.3125 |
|                                                 |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =  32.44548 |
|------------------------------------------------------------------------------------------------------|
|                                                                                                      |
|   CANCER                 FETAL                            CHILD                         ADULT         |
|                 LATENCY  PLATEAU  DEATH RATE     LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|                                                                                                      |
|   LEUKEMIA          0       0       0.0             0        0       0.0             2       25      1.000 |
|   ALL OTHER         0       0       0.0             0        0       0.0            15      110      3.500 |
|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
|                                                                                                      |
|                 CANCER                  FETAL          CHILD          ADULT           TOTAL          |
|                                                                                                      |
|                 LEUKEMIA                  0.0            0.0         66.93624        66.93624        |
|                 ALL OTHER                 0.0            0.0        299.68282       299.68282        |
|                 TOTAL                     0.0            0.0        366.61907       366.61907        |
|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
|                                                                                                      |
|                 NUMBER OF DEATHS CAUSED BY NON-RADIATION RISKS                         653.39601     |
|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
|                                                                                                      |
|                 TOTAL NUMBER OF INCREMENTAL DEATHS                                    1061.11230     |
|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
***   END OF RUN   ***
```

Sample Problem 5.

This problem examines the exposure of the female population to a lifetime annual dose of 0.5 rem. In addition to the summary and life tables, two tables are provided which show the age distribution of the radiation deaths by stage of exposure and cancer type.

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

 CHILD AND ADULT RADIATION DOSE TO FEMALE POPULATION = 0.5REM/PERSON/AGE0-110
2121441       6   10    0    0    0    0    0    0    0    0    0    0
  110    0    0    0    0    0    0    0    0       0.5       0.0       0.0
       0.0       0.0       0.0       0.0       0.0       0.0
12  1       LEUKEMIA         0    0  0.0    2   25  2.0    2   25  1.0
12  2         BREAST         0    0  0.0    0    0  0.0   15  110  3.0
12  3           LUNG         0    0  0.0    0    0  0.0   15  110  1.3
12  4     GI W/STOM.         0    0  0.0    0    0  0.0   15  110  1.0
12  5           BONE         0    0  0.0    0    0  0.0   15  110  0.2
12  6     ALL OTHERS         0    0  0.0   15  110  1.0   15  110  1.0
 ***   END OF RUN    ***
```

```
|------------------------------------------------------------------------------------------------------------|
|                CHILD AND ADULT RADIATION DOSE TO FEMALE POPULATION = 0.5REM/PERSON/AGE0-110                 |
|                                                                                                            |
|                                       POPULATION AT RISK: FEMALE                                           |
|  NUMBER OF DOSE RATES: ONE                                      REFERENCE TABLE INPUT SOURCE: DISK         |
|  RADIATION RISK MODEL: ABSOLUTE                                        ADDITIONAL ANALYSIS: STAGES & CANCERS |
|      ADDITIONAL RISK: NONE                                              ADDITIONAL OUTPUT: NONE    ONE    TWO |
|------------------------------------------------------------------------------------------------------------|
|                 ***   INPUT DATA   ***                   |                 ***   OUTPUT DATA   ***          |
|                                                          |                                                |
|         DOSE                          AGE INTERVAL       |                                                |
|          0.500000000                    0 - 110          |                                                |
|      CHILD AGE INTERVAL =               0 -  10          |  NUMBER OF PREMATURE DEATHS =           566.20532 |
|      ADULT AGE INTERVAL =              10 - 110          |  DECREASE IN POPULATION LIFE EXPECTANCY =  0.12728 |
|      OUTPUT DATA BASED ON AGE INTERVAL = 0 - 110         |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 12728.4727 |
|                                                          |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 22.48030 |
|------------------------------------------------------------------------------------------------------------|
|                                                                                                            |
|    CANCER                     FETAL                              CHILD                         ADULT       |
|                     LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE     LATENCY  PLATEAU  DEATH RATE |
|                                                                                                            |
|     LEUKEMIA           0        0       0.0              2        25      2.000           2        25      1.000 |
|      BREAST            0        0       0.0              0         0      0.0            15       110      3.000 |
|       LUNG             0        0       0.0              0         0      0.0            15       110      1.300 |
|    GI W/STOM.          0        0       0.0              0         0      0.0            15       110      1.000 |
|       BONE             0        0       0.0              0         0      0.0            15       110      0.200 |
|    ALL OTHERS          0        0       0.0             15       110      1.000          15       110      1.000 |
|------------------------------------------------------------------------------------------------------------|
|                     CANCER                FETAL        CHILD         ADULT          TOTAL                  |
|                                                                                                            |
|                    LEUKEMIA                0.0        24.31237       63.25590        87.56827              |
|                     BREAST                 0.0         0.0          208.22997       208.22997              |
|                      LUNG                  0.0         0.0           90.23294        90.23294              |
|                   GI W/STOM.               0.0         0.0           69.40997        69.40997              |
|                      BONE                  0.0         0.0           13.88200        13.88200              |
|                   ALL OTHERS               0.0        27.47919       69.40997        96.88916              |
|                  TOTAL                     0.0        51.79156      514.42075       566.21231              |
|------------------------------------------------------------------------------------------------------------|
|                                                                                                            |
|                  TOTAL NUMBER OF INCREMENTAL DEATHS                                   566.20532             |
|------------------------------------------------------------------------------------------------------------|
```

GENERATED LIFE TABLE FOR FEMALES: UNITED STATES 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
0- 1	0.0174600000	0.0	0.0174600000	100000.0000	1746.0000	99127.0000	7452295.7044	74.522957	0.0
1- 2	0.0011704360	0.0	0.0011704360	98254.0000	115.0000	98196.5000	7353168.7044	74.838365	0.0
2- 3	0.0007642218	0.0000004998	0.0007647216	98139.0000	75.0490	98101.4755	7254972.2044	73.925475	0.0491
3- 4	0.0006016475	0.0000014995	0.0006031471	98063.9510	59.1470	98034.3775	7156870.7289	72.981668	0.1471
4- 5	0.0005101774	0.0000024994	0.0005126767	98004.8040	50.2448	97979.6816	7058836.3514	72.025412	0.2449
5- 6	0.0004287672	0.0000034992	0.0004322665	97954.5592	42.3425	97933.3880	6960856.6698	71.062100	0.3428
6- 7	0.0003778851	0.0000044991	0.0003823843	97912.2167	37.4401	97893.4967	6862923.2819	70.092615	0.4405
7- 8	0.0003473770	0.0000054990	0.0003528761	97874.7766	34.5377	97857.5078	6765029.7852	69.119236	0.5382
8- 9	0.0003066160	0.0000064990	0.0003131150	97840.2390	30.6352	97824.9213	6667172.2774	68.143459	0.6359
9- 10	0.0002862619	0.0000074989	0.0002937608	97809.6037	28.7326	97795.2374	6569347.3561	67.164645	0.7335
10- 11	0.0002556639	0.0000084989	0.0002641628	97780.8711	25.8301	97767.9561	6471552.1187	66.184235	0.8310
11- 12	0.0002557298	0.0000094987	0.0002652285	97755.0410	25.9274	97742.0773	6373784.1626	65.201591	0.9285
12- 13	0.0002762586	0.0000102485	0.0002865071	97729.1136	28.0001	97715.1136	6276042.0853	64.218756	1.0016
13- 14	0.0003172733	0.0000107482	0.0003280215	97701.1135	32.0481	97685.0895	6178326.9717	63.237017	1.0501
14- 15	0.0004095147	0.0000112476	0.0004207623	97669.0654	41.0955	97648.5177	6080641.8823	62.257603	1.0985
15- 16	0.0004916191	0.0000119970	0.0005036160	97627.9700	49.1670	97603.3865	5982993.3645	61.283599	1.1712
16- 17	0.0005840842	0.0000129961	0.0005970803	97578.8030	58.2624	97549.6718	5885389.9781	60.314226	1.2681
17- 18	0.0006561974	0.0000139953	0.0006701927	97520.5406	65.3576	97487.8618	5787840.3063	59.349961	1.3648
18- 19	0.0006874068	0.0000149947	0.0007024016	97455.1830	68.4527	97420.9567	5690352.4445	58.389429	1.4613
19- 20	0.0007084133	0.0000159942	0.0007244075	97386.7304	70.5477	97351.4565	5592931.4878	57.430119	1.5576
20- 21	0.0007191889	0.0000169937	0.0007361826	97316.1827	71.6425	97280.3614	5495580.0313	56.471389	1.6538
21- 22	0.0007299884	0.0000179933	0.0007479817	97244.5402	72.7371	97208.1716	5398299.6698	55.512625	1.7497
22- 23	0.0007510989	0.0000189927	0.0007700915	97171.8031	74.8312	97134.3875	5301091.4982	54.553804	1.8456
23- 24	0.0007722563	0.0000199921	0.0007922483	97096.9719	76.9249	97058.5094	5203957.1107	53.595462	1.9412
24- 25	0.0007831578	0.0000209915	0.0008041493	97020.0470	78.0186	96981.0377	5106898.6013	52.637561	2.0366
25- 26	0.0008043966	0.0000233653	0.0008277619	96942.0284	80.2449	96901.9059	5009917.5636	51.679521	2.2651
26- 27	0.0008360057	0.0000271133	0.0008631189	96861.7834	83.6032	96819.9818	4913015.6578	50.721920	2.6262
27- 28	0.0008573630	0.0000303615	0.0008877245	96778.1802	85.9124	96735.2240	4816195.6759	49.765305	2.9383
28- 29	0.0009097899	0.0000331094	0.0009428993	96692.2678	91.1711	96646.6823	4719460.4519	48.809078	3.2014
29- 30	0.0009520089	0.0000358573	0.0009878662	96601.0968	95.4290	96553.3823	4622813.7696	47.854672	3.4639
30- 31	0.0010254192	0.0000386044	0.0010640236	96505.6678	102.6843	96454.3257	4526260.3873	46.901498	3.7255
31- 32	0.0010990493	0.0000413514	0.0011404007	96402.9835	109.9380	96348.0145	4429806.0617	45.950923	3.9864
32- 33	0.0011936747	0.0000440977	0.0012377723	96293.0455	119.1889	96233.4510	4333458.0472	45.002814	4.2463
33- 34	0.0012782371	0.0000468439	0.0013250810	96173.8566	127.4381	96110.1375	4237224.5962	44.057967	4.5052
34- 35	0.0014047372	0.0000495889	0.0014543261	96046.4185	139.6828	95976.5770	4141114.4586	43.115761	4.7628
35- 36	0.0015109125	0.0000523340	0.0015632465	95906.7356	149.9259	95831.7727	4045137.8816	42.177829	5.0192
36- 37	0.0016592983	0.0000550777	0.0017143760	95756.8098	164.1632	95674.7282	3949306.1089	41.243084	5.2741
37- 38	0.0017979448	0.0000580710	0.0018560158	95592.6466	177.4215	95503.9359	3853631.3807	40.313052	5.5512
38- 39	0.0019687316	0.0000613127	0.0020300443	95415.2251	193.6971	95318.3766	3758127.4448	39.387084	5.8502
39- 40	0.0021509876	0.0000645534	0.0022155409	95221.5280	210.9672	95116.0444	3662809.0683	38.466187	6.1469

GENERATED LIFE TABLE FOR FEMALES: UNITED STATES 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
40- 41	0.0023238642	0.0000677938	0.0023916580	95010.5608	227.2328	94896.9444	3567693.0239	37.550489	6.4411
41- 42	0.0025189875	0.0000710329	0.0025900204	94783.3280	245.4908	94660.5827	3472796.0795	36.639314	6.7327
42- 43	0.0027261048	0.0000742708	0.0028003756	94537.8373	264.7415	94405.4666	3378135.4968	35.733158	7.0214
43- 44	0.0029772416	0.0000775064	0.0030547480	94273.0958	287.9806	94129.1056	3283730.0303	34.832101	7.3068
44- 45	0.0032411711	0.0000807406	0.0033219118	93985.1153	312.2103	93829.0101	3189600.9247	33.937299	7.5884
45- 46	0.0035395614	0.0000839725	0.0036235339	93672.9050	339.4269	93503.1915	3095771.9146	33.048745	7.8660
46- 47	0.0038517061	0.0000872029	0.0039389089	93333.4781	367.6321	93149.6620	3002268.7230	32.167115	8.1389
47- 48	0.0041565880	0.0000904325	0.0042470206	92965.8460	394.8279	92768.4321	2909119.0610	31.292342	8.4071
48- 49	0.0044759214	0.0000936605	0.0045695819	92571.0181	423.0108	92359.5127	2816350.6289	30.423676	8.6702
49- 50	0.0048427214	0.0000968851	0.0049396065	92148.0073	455.1749	91920.4198	2723991.1162	29.561042	8.9278
50- 51	0.0052255364	0.0001001077	0.0053256441	91692.8324	488.3234	91448.6707	2632070.6964	28.705305	9.1792
51- 52	0.0056578957	0.0001033264	0.0057612221	91204.5090	525.4494	90941.7843	2540622.0257	27.856320	9.4238
52- 53	0.0061083096	0.0001065428	0.0062148524	90679.0596	563.5570	90397.2811	2449680.2414	27.014840	9.6612
53- 54	0.0065998588	0.0001097555	0.0067096143	90115.5026	604.6403	89813.1825	2359282.9603	26.180656	9.8907
54- 55	0.0071118783	0.0001129654	0.0072248437	89510.8623	646.7020	89187.5113	2269469.7778	25.354127	10.1116
55- 56	0.0076792519	0.0001161704	0.0077954223	88864.1603	692.7337	88517.7935	2180282.2665	24.535001	10.3234
56- 57	0.0082930490	0.0001193707	0.0084124197	88171.4267	741.7350	87800.5592	2091764.4730	23.723836	10.5251
57- 58	0.0089442198	0.0001225668	0.0090667866	87429.6916	792.7064	87033.3385	2003963.9138	22.920862	10.7160
58- 59	0.0096120126	0.0001257596	0.0097377722	86636.9853	843.6512	86215.1597	1916930.5754	22.126007	10.8954
59- 60	0.0103561843	0.0001289454	0.0104851296	85793.3341	899.5542	85343.5569	1830715.4157	21.338667	11.0627
60- 61	0.0111339974	0.0001321264	0.0112661238	84893.7798	956.4238	84415.5679	1745371.8587	20.559479	11.2167
61- 62	0.0119957204	0.0001352993	0.0121310197	83937.3560	1018.2457	83428.2331	1660956.2908	19.788046	11.3567
62- 63	0.0129828351	0.0001384605	0.0131212957	82919.1103	1088.0062	82375.1072	1577528.0577	19.024903	11.4810
63- 64	0.0141035793	0.0001416091	0.0142451884	81831.1041	1165.6995	81248.2544	1495152.9505	18.271206	11.5880
64- 65	0.0153800808	0.0001447426	0.0155248234	80665.4046	1252.3162	80039.2465	1413904.6962	17.528018	11.6757
65- 66	0.0167745887	0.0001478631	0.0169224519	79413.0884	1343.8642	78741.1564	1333865.4496	16.796544	11.7423
66- 67	0.0183112987	0.0001509683	0.0184622670	78069.2243	1441.3349	77348.5568	1255124.2933	16.077069	11.7860
67- 68	0.0200436940	0.0001540533	0.0201977473	76627.8894	1547.7107	75854.0340	1177775.7364	15.370066	11.8048
68- 69	0.0219392713	0.0001571196	0.0220963910	75080.1787	1659.0010	74250.6782	1101921.7024	14.676599	11.7966
69- 70	0.0240723971	0.0001601606	0.0242325577	73421.1777	1779.1829	72531.5862	1027671.0242	13.996929	11.7592
70- 71	0.0263198593	0.0001631851	0.0264830444	71641.9948	1897.2981	70693.3457	955139.4380	13.332117	11.6909
71- 72	0.0287868059	0.0001661838	0.0289529897	69744.6966	2019.3175	68735.0379	884446.0923	12.681195	11.5904
72- 73	0.0316533099	0.0001691402	0.0318224500	67725.3792	2155.1875	66647.7854	815711.0544	12.044393	11.4551
73- 74	0.0350250638	0.0001720430	0.0351971068	65570.1917	2307.8810	64416.2511	749063.2690	11.423838	11.2809
74- 75	0.0389227071	0.0001748879	0.0390975950	63262.3106	2473.4042	62025.6085	684647.0178	10.822352	11.0638
75- 76	0.0432481585	0.0001776813	0.0434258398	60788.9064	2639.8093	59469.0018	622621.4093	10.242353	10.8011
76- 77	0.0478883993	0.0001804316	0.0480688309	58149.0971	2795.1591	56751.5176	563152.4075	9.684629	10.4919
77- 78	0.0529378084	0.0001831282	0.0531209366	55353.9380	2940.4530	53883.7115	506400.8900	9.148417	10.1369
78- 79	0.0584007820	0.0001857689	0.0585865509	52413.4850	3070.7253	50878.1223	452517.1785	8.633602	9.7368
79- 80	0.0643196602	0.0001883475	0.0645080077	49342.7597	3183.0031	47751.2581	401639.0562	8.139777	9.2936

GENERATED LIFE TABLE FOR FEMALES: UNITED STATES 1969-71

X TO X+T	TQX	IXR	TQXR	LXR	DXR	TLXR	TXR	EXR	IXRLXR
YEARS									
80- 81	0.0709588866	0.0001908355	0.0711497221	46159.7565	3284.2539	44517.6296	353887.7981	7.666587	8.8089
81- 82	0.0783256489	0.0001932289	0.0785188777	42175.5027	3366.5364	41192.2345	309370.1685	7.215546	8.2848
82- 83	0.0861139362	0.0001955552	0.0863094913	39508.9663	3409.9988	37803.9669	268177.9340	6.787774	7.7262
83- 84	0.0941740430	0.0001978279	0.0943718709	36098.9675	3406.7271	34395.6040	230373.9670	6.381733	7.1414
84- 85	0.1027508779	0.0002000200	0.1029508979	32692.2404	3365.6955	31009.3927	195978.3630	5.994645	6.5391
85- 86	0.1127924513	0.0002020274	0.1129944787	29326.5449	3313.7377	27669.6761	164968.9703	5.625244	5.9248
86- 87	0.1246152479	0.0002038086	0.1248190565	26012.8073	3246.8941	24389.3602	137299.2942	5.278142	5.3016
87- 88	0.1368211616	0.0002055091	0.1370266707	22765.9132	3119.5373	21206.1446	112909.9340	4.959605	4.6786
88- 89	0.1486134578	0.0002072163	0.1488206741	19646.3759	2923.7869	18184.4825	91703.7894	4.667720	4.0710
89- 90	0.1600259913	0.0002089282	0.1602349195	16722.5890	2679.5427	15382.8177	73519.3069	4.396407	3.4938
90- 91	0.1726513207	0.0002104634	0.1728617841	14043.0463	2427.5060	12829.2933	58136.4893	4.139877	2.9555
91- 92	0.1870907321	0.0002117456	0.1873024777	11615.5403	2175.6195	10527.7305	45307.1960	3.900567	2.4595
92- 93	0.2024356601	0.0002128737	0.2026485338	9439.9208	1912.9861	8483.4277	34779.4655	3.684296	2.0095
93- 94	0.2174882487	0.0002139870	0.2177022357	7526.9347	1638.6305	6707.6194	26296.0377	3.493592	1.6107
94- 95	0.2318444843	0.0002151361	0.2320596204	5888.3042	1366.4376	5205.0854	19588.4183	3.326665	1.2668
95- 96	0.2457565514	0.0002162934	0.2459728447	4521.8665	1112.2564	3965.7384	14383.3329	3.180840	0.9780
96- 97	0.2584673794	0.0002175554	0.2586849349	3409.6102	882.0148	2968.6028	10417.5946	3.055362	0.7418
97- 98	0.2698490298	0.0002189444	0.2700679742	2527.5954	682.6226	2186.2841	7448.9918	2.947067	0.5534
98- 99	0.2800120499	0.0002204526	0.2802325025	1844.9728	517.0214	1586.4621	5262.7077	2.852458	0.4067
99-100	0.2890886127	0.0002220688	0.2893106814	1327.9515	384.1905	1135.8562	3676.2455	2.768358	0.2949
100-101	0.2987087410	0.0002235840	0.2989323250	943.7609	282.1206	802.7006	2540.3893	2.691772	0.2110
101-102	0.3063929810	0.0002253255	0.3066183065	661.6403	202.8710	560.2048	1737.6887	2.626335	0.1491
102-103	0.3146194635	0.0002269690	0.3148464325	458.7693	144.4419	386.5483	1177.4840	2.566615	0.1041
103-104	0.3207180105	0.0002288758	0.3209468863	314.3274	100.8824	263.8862	790.9356	2.516280	0.0719
104-105	0.3286658196	0.0002305078	0.3288963274	213.4450	70.2013	178.3444	527.0494	2.469252	0.0492
105-106	0.3309959344	0.0002328978	0.3312288322	143.2437	47.4464	119.5205	348.7051	2.434348	0.0334
106-107	0.3301672669	0.0002357261	0.3304029930	95.7973	31.6517	79.9714	229.1846	2.392392	0.0226
107-108	0.3437093507	0.0002365051	0.3439458558	64.1456	22.0626	53.1143	149.2132	2.326165	0.0152
108-109	0.3571004888	0.0002372619	0.3573377507	42.0830	15.0378	34.5640	96.0989	2.283559	0.0100
109-110	0.3332927650	0.0002434078	0.3335361728	27.0451	9.0205	22.5349	61.5349	2.275266	0.0066

AGE DISTRIBUTION OF RADIATION DEATHS BY STAGE FOR ALL CANCERS COMBINED

AGES	FETAL	CHILD	ADULT	TOTAL
0- 1	0.0	0.0	0.0	0.0
1- 2	0.0	0.0	0.0	0.0
2- 3	0.0	0.05	0.0	0.05
3- 4	0.0	0.15	0.0	0.15
4- 5	0.0	0.24	0.0	0.24
5- 6	0.0	0.34	0.0	0.34
6- 7	0.0	0.44	0.0	0.44
7- 8	0.0	0.54	0.0	0.54
8- 9	0.0	0.64	0.0	0.64
9- 10	0.0	0.73	0.0	0.73
10- 11	0.0	0.83	0.0	0.83
11- 12	0.0	0.93	0.0	0.93
12- 13	0.0	0.98	0.02	1.00
13- 14	0.0	0.98	0.07	1.05
14- 15	0.0	0.98	0.12	1.10
15- 16	0.0	1.00	0.17	1.17
16- 17	0.0	1.05	0.22	1.27
17- 18	0.0	1.10	0.27	1.36
18- 19	0.0	1.14	0.32	1.46
19- 20	0.0	1.19	0.37	1.56
20- 21	0.0	1.24	0.41	1.65
21- 22	0.0	1.29	0.46	1.75
22- 23	0.0	1.34	0.51	1.85
23- 24	0.0	1.38	0.56	1.94
24- 25	0.0	1.43	0.61	2.04
25- 26	0.0	1.45	0.81	2.27
26- 27	0.0	1.45	1.17	2.63
27- 28	0.0	1.40	1.54	2.94
28- 29	0.0	1.30	1.90	3.20
29- 30	0.0	1.21	2.26	3.46
30- 31	0.0	1.11	2.62	3.73
31- 32	0.0	1.01	2.97	3.99
32- 33	0.0	0.91	3.33	4.25
33- 34	0.0	0.82	3.69	4.51
34- 35	0.0	0.72	4.04	4.76
35- 36	0.0	0.62	4.40	5.02
36- 37	0.0	0.53	4.75	5.27
37- 38	0.0	0.48	5.07	5.55
38- 39	0.0	0.48	5.37	5.85
39- 40	0.0	0.48	5.67	6.15

AGE DISTRIBUTION OF RADIATION DEATHS BY STAGE FOR ALL CANCERS COMBINED

AGES	FETAL	CHILD	ADULT	TOTAL
40- 41	0.0	0.47	5.97	6.44
41- 42	0.0	0.47	6.26	6.73
42- 43	0.0	0.47	6.55	7.02
43- 44	0.0	0.47	6.84	7.31
44- 45	0.0	0.47	7.12	7.59
45- 46	0.0	0.47	7.40	7.87
46- 47	0.0	0.47	7.67	8.14
47- 48	0.0	0.46	7.94	8.41
48- 49	0.0	0.46	8.21	8.67
49- 50	0.0	0.46	8.47	8.93
50- 51	0.0	0.46	8.72	9.18
51- 52	0.0	0.45	8.97	9.42
52- 53	0.0	0.45	9.21	9.66
53- 54	0.0	0.45	9.44	9.89
54- 55	0.0	0.45	9.67	10.11
55- 56	0.0	0.44	9.88	10.32
56- 57	0.0	0.44	10.09	10.53
57- 58	0.0	0.44	10.28	10.72
58- 59	0.0	0.43	10.46	10.90
59- 60	0.0	0.43	10.64	11.06
60- 61	0.0	0.42	10.79	11.22
61- 62	0.0	0.42	10.94	11.36
62- 63	0.0	0.41	11.07	11.48
63- 64	0.0	0.41	11.18	11.59
64- 65	0.0	0.40	11.28	11.68
65- 66	0.0	0.39	11.35	11.74
66- 67	0.0	0.39	11.40	11.79
67- 68	0.0	0.38	11.43	11.80
68- 69	0.0	0.37	11.43	11.80
69- 70	0.0	0.36	11.40	11.76
70- 71	0.0	0.35	11.34	11.69
71- 72	0.0	0.34	11.25	11.59
72- 73	0.0	0.33	11.12	11.46
73- 74	0.0	0.32	10.96	11.28
74- 75	0.0	0.31	10.75	11.06
75- 76	0.0	0.30	10.50	10.80
76- 77	0.0	0.28	10.21	10.49
77- 78	0.0	0.27	9.87	10.14
78- 79	0.0	0.25	9.48	9.74
79- 80	0.0	0.24	9.05	9.29

AGE DISTRIBUTION OF RADIATION DEATHS BY STAGE FOR ALL CANCERS COMBINED				
AGES	FETAL	CHILD	ADULT	TOTAL
80- 81	0.0	0.22	8.59	8.81
81- 82	0.0	0.21	8.08	8.28
82- 83	0.0	0.19	7.54	7.73
83- 84	0.0	0.17	6.97	7.14
84- 85	0.0	0.16	6.38	6.54
85- 86	0.0	0.14	5.79	5.92
86- 87	0.0	0.12	5.18	5.30
87- 88	0.0	0.11	4.57	4.68
88- 89	0.0	0.09	3.98	4.07
89- 90	0.0	0.08	3.42	3.49
90- 91	0.0	0.06	2.89	2.96
91- 92	0.0	0.05	2.41	2.46
92- 93	0.0	0.04	1.97	2.01
93- 94	0.0	0.03	1.58	1.61
94- 95	0.0	0.03	1.24	1.27
95- 96	0.0	0.02	0.96	0.98
96- 97	0.0	0.01	0.73	0.74
97- 98	0.0	0.01	0.54	0.55
98- 99	0.0	0.01	0.40	0.41
99-100	0.0	0.01	0.29	0.29
100-101	0.0	0.00	0.21	0.21
101-102	0.0	0.00	0.15	0.15
102-103	0.0	0.00	0.10	0.10
103-104	0.0	0.00	0.07	0.07
104-105	0.0	0.00	0.05	0.05
105-106	0.0	0.00	0.03	0.03
106-107	0.0	0.00	0.02	0.02
107-108	0.0	0.00	0.01	0.02
108-109	0.0	0.00	0.01	0.01
109-110	0.0	0.00	0.01	0.01

AGE DISTRIBUTION OF RADIATION DEATHS BY CANCER TYPE FOR ALL STAGES COMBINED

AGES	LEUKEMIA	BREAST	LUNG	GI W/STOM.	BONE	ALL OTHERS		TOTAL
0- 1	0.0	0.0	0.0	0.0	0.0	0.0		0.0
1- 2	0.0	0.0	0.0	0.0	0.0	0.0		0.0
2- 3	0.05	0.0	0.0	0.0	0.0	0.0		0.05
3- 4	0.15	0.0	0.0	0.0	0.0	0.0		0.15
4- 5	0.24	0.0	0.0	0.0	0.0	0.0		0.24
5- 6	0.34	0.0	0.0	0.0	0.0	0.0		0.34
6- 7	0.44	0.0	0.0	0.0	0.0	0.0		0.44
7- 8	0.54	0.0	0.0	0.0	0.0	0.0		0.54
8- 9	0.64	0.0	0.0	0.0	0.0	0.0		0.64
9- 10	0.73	0.0	0.0	0.0	0.0	0.0		0.73
10- 11	0.83	0.0	0.0	0.0	0.0	0.0		0.83
11- 12	0.93	0.0	0.0	0.0	0.0	0.0		0.93
12- 13	1.00	0.0	0.0	0.0	0.0	0.0		1.00
13- 14	1.05	0.0	0.0	0.0	0.0	0.0		1.05
14- 15	1.10	0.0	0.0	0.0	0.0	0.0		1.10
15- 16	1.15	0.0	0.0	0.0	0.0	0.02		1.17
16- 17	1.19	0.0	0.0	0.0	0.0	0.07		1.27
17- 18	1.24	0.0	0.0	0.0	0.0	0.12		1.36
18- 19	1.29	0.0	0.0	0.0	0.0	0.17		1.46
19- 20	1.34	0.0	0.0	0.0	0.0	0.22		1.56
20- 21	1.39	0.0	0.0	0.0	0.0	0.27		1.65
21- 22	1.43	0.0	0.0	0.0	0.0	0.32		1.75
22- 23	1.48	0.0	0.0	0.0	0.0	0.36		1.85
23- 24	1.53	0.0	0.0	0.0	0.0	0.41		1.94
24- 25	1.58	0.0	0.0	0.0	0.0	0.46		2.04
25- 26	1.62	0.07	0.03	0.02	0.00	0.51		2.27
26- 27	1.67	0.22	0.09	0.07	0.01	0.56		2.63
27- 28	1.67	0.36	0.16	0.12	0.02	0.60		2.94
28- 29	1.62	0.51	0.22	0.17	0.03	0.65		3.20
29- 30	1.57	0.65	0.28	0.22	0.04	0.70		3.46
30- 31	1.52	0.80	0.34	0.27	0.05	0.75		3.73
31- 32	1.47	0.94	0.41	0.31	0.06	0.79		3.99
32- 33	1.42	1.08	0.47	0.36	0.07	0.84		4.25
33- 34	1.37	1.23	0.53	0.41	0.08	0.89		4.51
34- 35	1.32	1.37	0.59	0.46	0.09	0.94		4.76
35- 36	1.27	1.51	0.65	0.50	0.10	0.98		5.02
36- 37	1.22	1.65	0.72	0.55	0.11	1.03		5.27
37- 38	1.19	1.79	0.78	0.60	0.12	1.07		5.55
38- 39	1.19	1.93	0.84	0.64	0.13	1.12		5.85
39- 40	1.19	2.07	0.90	0.69	0.14	1.17		6.15

AGE DISTRIBUTION OF RADIATION DEATHS BY CANCER TYPE FOR ALL STAGES COMBINED

AGES	LEUKEMIA	BREAST	LUNG	GI W/STOM.	BONE	ALL OTHERS		TOTAL
40- 41	1.19	2.21	0.96	0.74	0.15	1.21		6.44
41- 42	1.18	2.34	1.02	0.78	0.16	1.25		6.73
42- 43	1.18	2.48	1.07	0.83	0.17	1.30		7.02
43- 44	1.18	2.61	1.13	0.87	0.17	1.34		7.31
44- 45	1.17	2.74	1.19	0.91	0.18	1.38		7.59
45- 46	1.17	2.88	1.25	0.96	0.19	1.43		7.87
46- 47	1.16	3.00	1.30	1.00	0.20	1.47		8.14
47- 48	1.16	3.13	1.36	1.04	0.21	1.51		8.41
48- 49	1.15	3.26	1.41	1.09	0.22	1.55		8.67
49- 50	1.15	3.38	1.46	1.13	0.23	1.59		8.93
50- 51	1.14	3.50	1.52	1.17	0.23	1.62		9.18
51- 52	1.14	3.61	1.57	1.20	0.24	1.66		9.42
52- 53	1.13	3.73	1.62	1.24	0.25	1.69		9.66
53- 54	1.12	3.84	1.66	1.28	0.26	1.73		9.89
54- 55	1.11	3.95	1.71	1.32	0.26	1.76		10.11
55- 56	1.11	4.05	1.75	1.35	0.27	1.79		10.32
56- 57	1.10	4.15	1.80	1.38	0.28	1.82		10.53
57- 58	1.09	4.24	1.84	1.41	0.28	1.85		10.72
58- 59	1.08	4.33	1.88	1.44	0.29	1.88		10.90
59- 60	1.07	4.42	1.91	1.47	0.29	1.90		11.06
60- 61	1.06	4.50	1.95	1.50	0.30	1.92		11.22
61- 62	1.04	4.57	1.98	1.52	0.30	1.94		11.36
62- 63	1.03	4.63	2.01	1.54	0.31	1.96		11.48
63- 64	1.02	4.69	2.03	1.56	0.31	1.97		11.59
64- 65	1.00	4.74	2.06	1.58	0.32	1.98		11.68
65- 66	0.98	4.78	2.07	1.59	0.32	1.99		11.74
66- 67	0.97	4.81	2.09	1.60	0.32	1.99		11.79
67- 68	0.95	4.84	2.10	1.61	0.32	1.99		11.80
68- 69	0.93	4.84	2.10	1.61	0.32	1.99		11.80
69- 70	0.91	4.84	2.10	1.61	0.32	1.98		11.76
70- 71	0.88	4.82	2.09	1.61	0.32	1.96		11.69
71- 72	0.86	4.79	2.08	1.60	0.32	1.94		11.59
72- 73	0.83	4.75	2.06	1.58	0.32	1.92		11.46
73- 74	0.81	4.69	2.03	1.56	0.31	1.88		11.28
74- 75	0.78	4.61	2.00	1.54	0.31	1.85		11.06
75- 76	0.74	4.50	1.95	1.50	0.30	1.80		10.80
76- 77	0.71	4.38	1.90	1.46	0.29	1.75		10.49
77- 78	0.67	4.24	1.84	1.41	0.28	1.68		10.14
78- 79	0.64	4.08	1.77	1.36	0.27	1.62		9.74
79- 80	0.60	3.90	1.69	1.30	0.26	1.54		9.29

```
|----------------------------------------------------------------------------------------------------|
|            AGE DISTRIBUTION OF RADIATION DEATHS BY CANCER TYPE FOR ALL STAGES COMBINED             |
|----------------------------------------------------------------------------------------------------|
|          |          |          |          |          |          |           |          |          |
|   AGES   | LEUKEMIA |  BREAST  |   LUNG   |GI W/STOM.|   BONE   | ALL OTHERS|          |  TOTAL   |
|          |          |          |          |          |          |           |          |          |
|----------------------------------------------------------------------------------------------------|
|          |          |          |          |          |          |           |          |          |
|  80- 81  |   0.56   |   3.71   |   1.61   |   1.24   |   0.25   |   1.46    |          |   8.81   |
|  81- 82  |   0.51   |   3.49   |   1.51   |   1.16   |   0.23   |   1.37    |          |   8.28   |
|  82- 83  |   0.47   |   3.26   |   1.41   |   1.09   |   0.22   |   1.28    |          |   7.73   |
|  83- 84  |   0.43   |   3.02   |   1.31   |   1.01   |   0.20   |   1.18    |          |   7.14   |
|  84- 85  |   0.39   |   2.77   |   1.20   |   0.92   |   0.18   |   1.08    |          |   6.54   |
|          |          |          |          |          |          |           |          |          |
|  85- 86  |   0.35   |   2.51   |   1.09   |   0.84   |   0.17   |   0.98    |          |   5.92   |
|  86- 87  |   0.30   |   2.25   |   0.97   |   0.75   |   0.15   |   0.87    |          |   5.30   |
|  87- 88  |   0.27   |   1.99   |   0.86   |   0.66   |   0.13   |   0.77    |          |   4.68   |
|  88- 89  |   0.23   |   1.73   |   0.75   |   0.58   |   0.12   |   0.67    |          |   4.07   |
|  89- 90  |   0.19   |   1.49   |   0.64   |   0.50   |   0.10   |   0.57    |          |   3.49   |
|          |          |          |          |          |          |           |          |          |
|  90- 91  |   0.16   |   1.26   |   0.55   |   0.42   |   0.08   |   0.48    |          |   2.96   |
|  91- 92  |   0.13   |   1.05   |   0.46   |   0.35   |   0.07   |   0.40    |          |   2.46   |
|  92- 93  |   0.11   |   0.86   |   0.37   |   0.29   |   0.06   |   0.33    |          |   2.01   |
|  93- 94  |   0.08   |   0.69   |   0.30   |   0.23   |   0.05   |   0.26    |          |   1.61   |
|  94- 95  |   0.07   |   0.54   |   0.24   |   0.18   |   0.04   |   0.21    |          |   1.27   |
|          |          |          |          |          |          |           |          |          |
|  95- 96  |   0.05   |   0.42   |   0.18   |   0.14   |   0.03   |   0.16    |          |   0.98   |
|  96- 97  |   0.04   |   0.32   |   0.14   |   0.11   |   0.02   |   0.12    |          |   0.74   |
|  97- 98  |   0.03   |   0.24   |   0.10   |   0.08   |   0.02   |   0.09    |          |   0.55   |
|  98- 99  |   0.02   |   0.17   |   0.08   |   0.06   |   0.01   |   0.07    |          |   0.41   |
|  99-100  |   0.01   |   0.13   |   0.06   |   0.04   |   0.01   |   0.05    |          |   0.29   |
|          |          |          |          |          |          |           |          |          |
| 100-101  |   0.01   |   0.09   |   0.04   |   0.03   |   0.01   |   0.03    |          |   0.21   |
| 101-102  |   0.01   |   0.06   |   0.03   |   0.02   |   0.00   |   0.02    |          |   0.15   |
| 102-103  |   0.00   |   0.04   |   0.02   |   0.01   |   0.00   |   0.02    |          |   0.10   |
| 103-104  |   0.00   |   0.03   |   0.01   |   0.01   |   0.00   |   0.01    |          |   0.07   |
| 104-105  |   0.00   |   0.02   |   0.01   |   0.01   |   0.00   |   0.01    |          |   0.05   |
|          |          |          |          |          |          |           |          |          |
| 105-106  |   0.00   |   0.01   |   0.01   |   0.00   |   0.00   |   0.01    |          |   0.03   |
| 106-107  |   0.00   |   0.01   |   0.00   |   0.00   |   0.00   |   0.00    |          |   0.02   |
| 107-108  |   0.00   |   0.01   |   0.00   |   0.00   |   0.00   |   0.00    |          |   0.02   |
| 108-109  |   0.00   |   0.00   |   0.00   |   0.00   |   0.00   |   0.00    |          |   0.01   |
| 109-110  |   0.00   |   0.00   |   0.00   |   0.00   |   0.00   |   0.00    |          |   0.01   |
|          |          |          |          |          |          |           |          |          |
|----------------------------------------------------------------------------------------------------|
|          |          |          |          |          |          |           |          |          |
|  TOTAL   |  87.57   |  208.23  |  90.23   |  69.41   |  13.88   |  96.89    |          |  566.21  |
|          |          |          |          |          |          |           |          |          |
|----------------------------------------------------------------------------------------------------|
|----------------------------------------------------------------------------------------------------|
***   END OF RUN   ***
```

Sample Problem 6.

All of the previous problems have dealt with whole body exposure. This problem examines a partial body exposure situation: dose to the liver from lifetime inhalation of CM-242. This radionuclide is absorbed and partially retained by the body. The continuous exposure results in accumulation of the radionuclide and an increasing annual dose. The cohort's 110 year "life" is divided into nine exposure intervals, each using an annual dose taken from internal dosimetry calculations.

Twelve cases are analyzed which show the effect of the absolute and relative risk models using 15 and 30-year latent periods, and 0.2x, 1x, and 10x radiosensitivity factors for child stage doses.

Input Data:

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8

TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK
3121419       1   10    0    0    2    3   12   17   22   35   45   60
    2    3   12   17   22   35   45   60  110   .000275   .000464   .000532
  .000596   .000660   .000766   .000843   .000911        .001
22  1     LIVER               0    0  0.0   15  110  .84   15  110  4.2
22  1     LIVER               0    0  0.0   30  110  .84   30  110  4.2
22  1     LIVER               0    0  0.0   15  110  4.2   15  110  4.2
22  1     LIVER               0    0  0.0   30  110  4.2   30  110  4.2
22  1     LIVER               0    0  0.0   15  110 42.0   15  110  4.2
12  1     LIVER               0    0  0.0   30  110 42.0   30  110  4.2
TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK
3131419       1   10    0    0    2    3   12   17   22   35   45   60
    2    8   12   17   22   35   45   60  110   .000275   .000464   .000532
  .000596   .000660   .000766   .000848   .000911        .001
21  1     LIVER               0    0  0.0   15  110 .022   15  110  .11
 000001559 000000244 000000341 000000596 000000951 000000911 000001606 000002161
 000004142 000009448 000016937 000028830 000038272 000051530 000060442 000066922
 000063339 000071373 000071373 000071373 000071373 000071373
22  1     LIVER               0    0  0.0   30  110 .022   30  110  .11
22  1     LIVER               0    0  0.0   15  110  .11   15  110  .11
22  1     LIVER               0    0  0.0   30  110  .11   30  110  .11
22  1     LIVER               0    0  0.0   15  110  1.1   15  110  .11
12  1     LIVER               0    0  0.0   30  110  1.1   30  110  .11
 ***   END OF RUN   ***
```

```
---------------------------------------------------------------------------------------------------------------
|                TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK             |
|                                                                                                             |
|                                              POPULATION AT RISK: GENERAL                                    |
|  NUMBER OF DOSE RATES: NINE                                    REFERENCE TABLE INPUT SOURCE: DISK           |
|  RADIATION RISK MODEL: ABSOLUTE                                       ADDITIONAL ANALYSIS: STAGES & CANCERS |
|       ADDITIONAL RISK: NONE                                              ADDITIONAL OUTPUT: NONE             |
---------------------------------------------------------------------------------------------------------------
|                ***   INPUT DATA   ***                   |                  ***   OUTPUT DATA   ***          |
|                                                         |                                                   |
|         DOSE                             AGE INTERVAL   |                                                   |
|          0.000275000                         0 -   2    |                                                   |
|          0.000464000                         2 -   8    |                                                   |
|          0.000532000                         8 -  12    |                                                   |
|          0.000596000                        12 -  17    |                                                   |
|          0.000660000                        17 -  22    |                                                   |
|          0.000766000                        22 -  35    |                                                   |
|          0.000848000                        35 -  45    |                                                   |
|          0.000911000                        45 -  60    |                                                   |
|          0.001000000                        60 - 110    |                                                   |
|      CHILD AGE INTERVAL =                    0 -  10    | NUMBER OF PREMATURE DEATHS =                 0.39772 |
|      ADULT AGE INTERVAL =                   10 - 110    | DECREASE IN POPULATION LIFE EXPECTANCY =     0.00007 |
|      OUTPUT DATA BASED ON AGE INTERVAL =     0 - 110    | TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 7.19927 |
|                                                         | AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 18.10124 |
---------------------------------------------------------------------------------------------------------------
|  CANCER                      FETAL                          CHILD                         ADULT            |
|                    LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|  LIVER               0        0        0.0           15       110      0.840          15       110      4.200  |
---------------------------------------------------------------------------------------------------------------
|                  CANCER                     FETAL          CHILD          ADULT            TOTAL           |
|                                                                                                             |
|                  LIVER                        0.0         0.01877        0.37895         0.39772           |
|                  TOTAL                        0.0         0.01877        0.37895         0.39772           |
---------------------------------------------------------------------------------------------------------------
|                  TOTAL NUMBER OF INCREMENTAL DEATHS                                      0.39772            |
---------------------------------------------------------------------------------------------------------------
```

```
|------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                        |
|                    TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK                    |
|                                                                                                                        |
|                                              POPULATION AT RISK: GENERAL                                               |
|   NUMBER OF DOSE RATES: NINE                                                                                           |
|   RADIATION RISK MODEL: ABSOLUTE                                            REFERENCE TABLE INPUT SOURCE: DISK         |
|        ADDITIONAL RISK: NONE                                                  ADDITIONAL ANALYSIS: STAGES & CANCERS    |
|                                                                                 ADDITIONAL OUTPUT: NONE                |
|------------------------------------------------------------------------------------------------------------------------|
|                                                          |                                                             |
|                ***   INPUT DATA   ***                    |                  ***   OUTPUT DATA   ***                    |
|                                                          |                                                             |
|          DOSE                          AGE INTERVAL      |                                                             |
|           0.000275000                      0 -   2       |                                                             |
|           0.000464000                      2 -   8       |                                                             |
|           0.000532000                      8 -  12       |                                                             |
|           0.000596000                     12 -  17       |                                                             |
|           0.000660000                     17 -  22       |                                                             |
|           0.000766000                     22 -  35       |                                                             |
|           0.000848000                     35 -  45       |                                                             |
|           0.000911000                     45 -  60       |                                                             |
|           0.001000000                     60 - 110       |                                                             |
|       CHILD AGE INTERVAL =                 0 -  10       |                                                             |
|       ADULT AGE INTERVAL =                10 - 110       |  NUMBER OF PREMATURE DEATHS =                       0.20029 |
|       OUTPUT DATA BASED ON AGE INTERVAL =  0 - 110       |  DECREASE IN POPULATION LIFE EXPECTANCY =           0.00003 |
|                                                          |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =     2.81565 |
|                                                          |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =  14.05774 |
|------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                        |
|     CANCER                         FETAL                            CHILD                           ADULT              |
|                          LATENCY  PLATEAU  DEATH RATE     LATENCY  PLATEAU  DEATH RATE     LATENCY  PLATEAU  DEATH RATE |
|                                                                                                                        |
|     LIVER                   0        0        0.0           30       110      0.840           30      110      4.200   |
|------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                        |
|                    CANCER                  FETAL         CHILD          ADULT              TOTAL                       |
|                                                                                                                        |
|                    LIVER                     0.0        0.01348        0.18682            0.20029                      |
|                    TOTAL                     0.0        0.01348        0.18682            0.20029                      |
|------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                        |
|                    TOTAL NUMBER OF INCREMENTAL DEATHS                                        0.20029                   |
|------------------------------------------------------------------------------------------------------------------------|
|------------------------------------------------------------------------------------------------------|
|                TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK        |
|                                                                                                      |
|                                        POPULATION AT RISK: GENERAL                                   |
|  NUMBER OF DOSE RATES: NINE                                                                          |
|  RADIATION RISK MODEL: ABSOLUTE                            REFERENCE TABLE INPUT SOURCE: DISK        |
|       ADDITIONAL RISK: NONE                                   ADDITIONAL ANALYSIS: STAGES & CANCERS |
|                                                                 ADDITIONAL OUTPUT: NONE             |
|------------------------------------------------------------------------------------------------------|
|              ***   INPUT DATA   ***                  |                                              |
|                                                      |            ***   OUTPUT DATA   ***            |
|         DOSE                          AGE INTERVAL    |                                              |
|          0.000275000                     0 -   2      |                                              |
|          0.000464000                     2 -   8      |                                              |
|          0.000532000                     8 -  12      |                                              |
|          0.000596000                    12 -  17      |                                              |
|          0.000660000                    17 -  22      |                                              |
|          0.000766000                    22 -  35      |                                              |
|          0.000848000                    35 -  45      |                                              |
|          0.000911000                    45 -  60      |                                              |
|          0.001000000                    60 - 110      |                                              |
|      CHILD AGE INTERVAL =                0 -  10      |                                              |
|      ADULT AGE INTERVAL =               10 - 110      | NUMBER OF PREMATURE DEATHS =                      0.47280 |
|      OUTPUT DATA BASED ON AGE INTERVAL = 0 - 110      | DECREASE IN POPULATION LIFE EXPECTANCY =          0.00009 |
|                                                      | TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =    9.33692 |
|                                                      | AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 19.74791 |
|------------------------------------------------------------------------------------------------------|
|   CANCER                                                                                             |
|                         FETAL                           CHILD                          ADULT        |
|               LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|   LIVER                                                                                              |
|                  0        0        0.0           15      110      4.200          15      110      4.200 |
|------------------------------------------------------------------------------------------------------|
|               CANCER                   FETAL        CHILD        ADULT           TOTAL               |
|                                                                                                      |
|               LIVER                     0.0        0.09385      0.37895         0.47281              |
|               TOTAL                     0.0        0.09385      0.37695         0.47281              |
|------------------------------------------------------------------------------------------------------|
|               TOTAL NUMBER OF INCREMENTAL DEATHS                                 0.47280             |
|------------------------------------------------------------------------------------------------------|
|------------------------------------------------------------------------------------------------------------|
|                     TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK       |
|                                                                                                            |
|                                        POPULATION AT RISK: GENERAL                                         |
|  NUMBER OF DOSE RATES: NINE                                          REFERENCE TABLE INPUT SOURCE: DISK    |
|  RADIATION RISK MODEL: ABSOLUTE                                             ADDITIONAL ANALYSIS: STAGES & CANCERS |
|      ADDITIONAL RISK: NONE                                                     ADDITIONAL OUTPUT: NONE      |
|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
|                  ***   INPUT DATA   ***                    |                  ***   OUTPUT DATA   ***      |
|                                                            |                                              |
|          DOSE                              AGE INTERVAL    |                                              |
|           0.000275000                           0 -   2    |                                              |
|           0.000464000                           2 -   8    |                                              |
|           0.000532000                           8 -  12    |                                              |
|           0.000596000                          12 -  17    |                                              |
|           0.000660000                          17 -  22    |                                              |
|           0.000766000                          22 -  35    |                                              |
|           0.000848000                          35 -  45    |                                              |
|           0.000911000                          45 -  60    |                                              |
|           0.001000000                          60 - 110    |                                              |
|       CHILD AGE INTERVAL =                      0 -  10    |  NUMBER OF PREMATURE DEATHS =                      0.25419 |
|       ADULT AGE INTERVAL =                     10 - 110    |  DECREASE IN POPULATION LIFE EXPECTANCY =          0.00004 |
|       OUTPUT DATA BASED ON AGE INTERVAL =       0 - 110    |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =    3.98654 |
|                                                            |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 15.68306 |
|------------------------------------------------------------------------------------------------------------|
|                                                                                                            |
|    CANCER                      FETAL                             CHILD                           ADULT     |
|                      LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE     LATENCY  PLATEAU  DEATH RATE |
|                                                                                                            |
|    LIVER                  0        0     0.0              30      110      4.200           30      110      4.200 |
|------------------------------------------------------------------------------------------------------------|
|                    CANCER                      FETAL          CHILD          ADULT           TOTAL         |
|                                                                                                            |
|                    LIVER                         0.0        0.06738        0.18682         0.25420         |
|                    TOTAL                         0.0        0.06738        0.18682         0.25420         |
|------------------------------------------------------------------------------------------------------------|
|                                                                                                            |
|                    TOTAL NUMBER OF INCREMENTAL DEATHS                                      0.25419         |
|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
--------------------------------------------------------------------------------------------------------------------
            TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK

 NUMBER OF DOSE RATES: NINE                         POPULATION AT RISK: GENERAL
 RADIATION RISK MODEL: ABSOLUTE                                        REFERENCE TABLE INPUT SOURCE: DISK
      ADDITIONAL RISK: NONE                                                 ADDITIONAL ANALYSIS: STAGES & CANCERS
                                                                              ADDITIONAL OUTPUT: NONE
--------------------------------------------------------------------------------------------------------------------
             ***   INPUT DATA   ***                  |
                                                     |              ***   OUTPUT DATA   ***
      DOSE                          AGE INTERVAL     |
       0.000275000                     0 -   2       |
       0.000464000                     2 -   8       |
       0.000532000                     8 -  12       |
       0.000596000                    12 -  17       |
       0.000660000                    17 -  22       |
       0.000766000                    22 -  35       |
       0.000848000                    35 -  45       |
       0.000911000                    45 -  60       |
       0.001000000                    60 - 110       |
   CHILD AGE INTERVAL =                0 -  10       |
   ADULT AGE INTERVAL =               10 - 110       | NUMBER OF PREMATURE DEATHS =
   OUTPUT DATA BASED ON AGE INTERVAL = 0 - 110       | DECREASE IN POPULATION LIFE EXPECTANCY =                1.31746
                                                     | TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =          0.00033
                                                     | AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =       33.38535
                                                                                                               25.34062
--------------------------------------------------------------------------------------------------------------------
  CANCER
                              FETAL                         CHILD                          ADULT
                    LATENCY  PLATEAU  DEATH RATE   LATENCY  PLATEAU  DEATH RATE   LATENCY  PLATEAU  DEATH RATE
  LIVER
                       0        0       0.0          15       110      42.000        15       110      4.200
--------------------------------------------------------------------------------------------------------------------
                  CANCER                   FETAL          CHILD          ADULT            TOTAL

                  LIVER                     0.0
                  TOTAL                     0.0          0.93854        0.37895          1.31749
                                                         0.93854        0.37895          1.31749
--------------------------------------------------------------------------------------------------------------------
                  TOTAL NUMBER OF INCREMENTAL DEATHS
                                                                                          1.31746
--------------------------------------------------------------------------------------------------------------------
```

```
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                       TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: ABSOLUTE RISK                            |
|                                                                                                                                    |
|                                                   POPULATION AT RISK: GENERAL                                                      |
|    NUMBER OF DOSE RATES: NINE                                                 REFERENCE TABLE INPUT SOURCE: DISK                  |
|    RADIATION RISK MODEL: ABSOLUTE                                                     ADDITIONAL ANALYSIS: STAGES & CANCERS        |
|         ADDITIONAL RISK: NONE                                                          ADDITIONAL OUTPUT: NONE                     |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                |                                                                   |
|               ***   INPUT DATA   ***                           |                    ***   OUTPUT DATA   ***                        |
|                                                                |                                                                   |
|        DOSE                               AGE INTERVAL         |                                                                   |
|         0.000275000                          0 -   2           |                                                                   |
|         0.000464000                          2 -   8           |                                                                   |
|         0.000532000                          8 -  12           |                                                                   |
|         0.000596000                         12 -  17           |                                                                   |
|         0.000660000                         17 -  22           |                                                                   |
|         0.000766000                         22 -  35           |                                                                   |
|         0.000848000                         35 -  45           |                                                                   |
|         0.000911000                         45 -  60           |                                                                   |
|         0.001000000                         60 - 110           |                                                                   |
|     CHILD AGE INTERVAL =                     0 -  10           |   NUMBER OF PREMATURE DEATHS =                            0.86059 |
|     ADULT AGE INTERVAL =                    10 - 110           |   DECREASE IN POPULATION LIFE EXPECTANCY =                0.00017 |
|     OUTPUT DATA BASED ON AGE INTERVAL =      0 - 110           |   TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =         17.15894 |
|                                                                |   AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =       19.93851 |
|                                                                |                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|    CANCER                     FETAL                              CHILD                               ADULT                        |
|                     LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE         |
|                                                                                                                                    |
|    LIVER                 0        0     0.0                30      110    42.000              30      110     4.200             |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                    CANCER                      FETAL           CHILD          ADULT                TOTAL                           |
|                                                                                                                                    |
|                    LIVER                         0.0         0.67376        0.18682              0.86059                           |
|                    TOTAL                         0.0         0.67376        0.18682              0.86059                           |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    |
|                    TOTAL NUMBER OF INCREMENTAL DEATHS                                              0.86059                         |
|                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------|
OTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK
```

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------------------------------------------------------------------------------------------------------------------------
|                                                                                                                      |
|                  TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK                    |
|                                                                                                                      |
|                                          POPULATION AT RISK: GENERAL                                                 |
|    NUMBER OF DOSE RATES: NINE                                          REFERENCE TABLE INPUT SOURCE: DISK            |
|    RADIATION RISK MODEL: RELATIVE                                              ADDITIONAL ANALYSIS: STAGES & CANCERS |
|         ADDITIONAL RISK: NONE                                                     ADDITIONAL OUTPUT: NONE            |
|                                                                                                                      |
------------------------------------------------------------------------------------------------------------------------
|                                                     |                                                                |
|               ***   INPUT DATA   ***                |                    ***   OUTPUT DATA   ***                     |
|                                                     |                                                                |
|          DOSE                         AGE INTERVAL   |                                                                |
|           0.000275000                     0 -   2    |                                                                |
|           0.000464000                     2 -   8    |                                                                |
|           0.000532000                     8 -  12    |                                                                |
|           0.000596000                    12 -  17    |                                                                |
|           0.000660000                    17 -  22    |                                                                |
|           0.000766000                    22 -  35    |                                                                |
|           0.000848000                    35 -  45    |                                                                |
|           0.000911000                    45 -  60    |                                                                |
|           0.001000000                    60 - 110    |                                                                |
|       CHILD AGE INTERVAL =                0 -  10    |  NUMBER OF PREMATURE DEATHS =                          0.40528 |
|       ADULT AGE INTERVAL =               10 - 110    |  DECREASE IN POPULATION LIFE EXPECTANCY =              0.00005 |
|       OUTPUT DATA BASED ON AGE INTERVAL =  0 - 110    |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =        4.83513 |
|                                                     |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =     11.93045 |
------------------------------------------------------------------------------------------------------------------------
|                                                                                                                      |
|    CANCER                       FETAL                              CHILD                             ADULT          |
|                       LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE |
|                                                                                                                      |
|    LIVER                 0        0       0.0              15      110      0.022            15       110      0.110  |
|                                                                                                                      |
------------------------------------------------------------------------------------------------------------------------
|                                                                                                                      |
|                      CANCER                    FETAL         CHILD          ADULT            TOTAL                  |
|                                                                                                                      |
|                      LIVER                      0.0         0.01050        0.39478          0.40528                 |
|                      TOTAL                      0.0         0.01050        0.39478          0.40528                 |
|                                                                                                                      |
------------------------------------------------------------------------------------------------------------------------
|                                                                                                                      |
|                      TOTAL NUMBER OF INCREMENTAL DEATHS                                     0.40528                 |
|                                                                                                                      |
------------------------------------------------------------------------------------------------------------------------
```

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|-------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                               |
|                          TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK                     |
|                                                                                                                               |
|                                                  POPULATION AT RISK: GENERAL                                                  |
|    NUMBER OF DOSE RATES: NINE                                                     REFERENCE TABLE INPUT SOURCE: DISK         |
|    RADIATION RISK MODEL: RELATIVE                                                         ADDITIONAL ANALYSIS: STAGES & CANCERS |
|         ADDITIONAL RISK: NONE                                                              ADDITIONAL OUTPUT: NONE            |
|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
|                                                              |                                                                |
|                   ***   INPUT DATA   ***                     |                   ***   OUTPUT DATA   ***                    |
|                                                              |                                                                |
|         DOSE                                AGE INTERVAL     |                                                                |
|          0.000275000                          0 -   2        |                                                                |
|          0.000464000                          2 -   8        |                                                                |
|          0.000532000                          8 -  12        |                                                                |
|          0.000596000                         12 -  17        |                                                                |
|          0.000660000                         17 -  22        |                                                                |
|          0.000766000                         22 -  35        |                                                                |
|          0.000848000                         35 -  45        |                                                                |
|          0.000911000                         45 -  60        |                                                                |
|          0.001000000                         60 - 110        |                                                                |
|      CHILD AGE INTERVAL =                     0 -  10        |  NUMBER OF PREMATURE DEATHS =                          0.25103 |
|      ADULT AGE INTERVAL =                    10 - 110        |  DECREASE IN POPULATION LIFE EXPECTANCY =              0.00003 |
|      OUTPUT DATA BASED ON AGE INTERVAL =      0 - 110        |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =        2.74694 |
|                                                              |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =     10.94261 |
|                                                              |                                                                |
|-------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                               |
|     CANCER                      FETAL                                  CHILD                              ADULT              |
|                      LATENCY   PLATEAU   DEATH RATE       LATENCY   PLATEAU   DEATH RATE       LATENCY   PLATEAU   DEATH RATE  |
|                                                                                                                               |
|     LIVER              0         0         0.0             30        110        0.022             30       110       0.110     |
|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                               |
|                     CANCER                          FETAL            CHILD          ADULT               TOTAL                 |
|                                                                                                                               |
|                     LIVER                             0.0          0.01033        0.24070             0.25103                 |
|                     TOTAL                             0.0          0.01033        0.24070             0.25103                 |
|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                               |
|                     TOTAL NUMBER OF INCREMENTAL DEATHS                                                  0.25103               |
|                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|             TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK              |
|                                                                                                           |
|                                        POPULATION AT RISK: GENERAL                                        |
|   NUMBER OF DOSE RATES: NINE                                   REFERENCE TABLE INPUT SOURCE: DISK         |
|   RADIATION RISK MODEL: RELATIVE                                  ADDITIONAL ANALYSIS: STAGES & CANCERS   |
|       ADDITIONAL RISK: NONE                                          ADDITIONAL OUTPUT: NONE              |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                    |                                                      |
|             ***   INPUT DATA   ***                 |               ***   OUTPUT DATA   ***                |
|                                                    |                                                      |
|      DOSE                       AGE INTERVAL       |                                                      |
|       0.000275000                  0 -   2         |                                                      |
|       0.000464000                  2 -   8         |                                                      |
|       0.000532000                  6 -  12         |                                                      |
|       0.000596000                 12 -  17         |                                                      |
|       0.000660000                 17 -  22         |                                                      |
|       0.000766000                 22 -  35         |                                                      |
|       0.000848000                 35 -  45         |                                                      |
|       0.000911000                 45 -  60         |                                                      |
|       0.001000000                 60 - 110         |                                                      |
|    CHILD AGE INTERVAL =            0 -  10         |  NUMBER OF PREMATURE DEATHS =                 0.44728 |
|    ADULT AGE INTERVAL =           10 - 110         |  DECREASE IN POPULATION LIFE EXPECTANCY =      0.00005 |
|    OUTPUT DATA BASED ON AGE INTERVAL =  0 - 110    |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS = 5.44420 |
|                                                    |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 12.17182 |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|   CANCER                    FETAL                              CHILD                       ADULT          |
|                    LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE   LATENCY  PLATEAU  DEATH RATE |
|                                                                                                           |
|   LIVER               0        0       0.0             15       110      0.110         15       110      0.110 |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|               CANCER                     FETAL         CHILD         ADULT          TOTAL                 |
|                                                                                                           |
|               LIVER                        0.0        0.05250       0.39478        0.44728                |
|               TOTAL                        0.0        0.05250       0.39478        0.44728                |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|                                                                                                           |
|               TOTAL NUMBER OF INCREMENTAL DEATHS                                     0.44728              |
|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                  |
|                        TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK          |
|                                                                                                                  |
|                                                   POPULATION AT RISK: GENERAL                                    |
|   NUMBER OF DOSE RATES: NINE                                                REFERENCE TABLE INPUT SOURCE: DISK   |
|   RADIATION RISK MODEL: RELATIVE                                                  ADDITIONAL ANALYSIS: STAGES & CANCERS |
|        ADDITIONAL RISK: NONE                                                       ADDITIONAL OUTPUT: NONE      |
|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
|                                                        |                                                         |
|                 ***   INPUT DATA   ***                 |                ***   OUTPUT DATA   ***                 |
|                                                        |                                                         |
|          DOSE                            AGE INTERVAL  |                                                         |
|           0.000275000                        0 -   2   |                                                         |
|           0.000464000                        2 -   8   |                                                         |
|           0.000532000                        8 -  12   |                                                         |
|           0.000596000                       12 -  17   |                                                         |
|           0.000660000                       17 -  22   |                                                         |
|           0.000766000                       22 -  35   |                                                         |
|           0.000848000                       35 -  45   |                                                         |
|           0.000911000                       45 -  60   |                                                         |
|           0.001000000                       60 - 110   |                                                         |
|       CHILD AGE INTERVAL =                   0 -  10   |  NUMBER OF PREMATURE DEATHS =                    0.29237 |
|       ADULT AGE INTERVAL =                  10 - 110   |  DECREASE IN POPULATION LIFE EXPECTANCY =        0.00003 |
|       OUTPUT DATA BASED ON AGE INTERVAL =    0 - 110   |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =  3.32657 |
|                                                        |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH = 11.37808 |
|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                  |
|    CANCER                      FETAL                              CHILD                         ADULT            |
|                       LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE    LATENCY  PLATEAU  DEATH RATE |
|                                                                                                                  |
|    LIVER                  0       0       0.0             30       110      0.110         30       110      0.110 |
|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                  |
|                     CANCER                        FETAL           CHILD           ADULT           TOTAL          |
|                                                                                                                  |
|                     LIVER                          0.0           0.05167         0.24070         0.29237         |
|                     TOTAL                          0.0           0.05167         0.24070         0.29237         |
|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                  |
|                     TOTAL NUMBER OF INCREMENTAL DEATHS                                            0.29237        |
|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
----------------------------------------------------------------------------------------------------------
         TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK

                                        POPULATION AT RISK: GENERAL
                                                            REFERENCE TABLE INPUT SOURCE: DISK
  NUMBER OF DOSE RATES: NINE                                         ADDITIONAL ANALYSIS: STAGES & CANCERS
  RADIATION RISK MODEL: RELATIVE                                      ADDITIONAL OUTPUT: NONE
       ADDITIONAL RISK: NONE
----------------------------------------------------------------------------------------------------------
                *** INPUT DATA ***                   |             *** OUTPUT DATA ***
                                                     |
         DOSE                           AGE INTERVAL |
          0.000275000                     0 -   2    |
          0.000464000                     2 -   8    |
          0.000532000                     8 -  12    |
          0.000596000                    12 -  17    |
          0.000660000                    17 -  22    |
          0.000766000                    22 -  35    |
          0.000848000                    35 -  45    |
          0.000911000                    45 -  60    |
          0.001000000                    60 - 110    |
     CHILD AGE INTERVAL =                 0 -  10    |  NUMBER OF PREMATURE DEATHS =                          0.91981
     ADULT AGE INTERVAL =                10 - 110    |  DECREASE IN POPULATION LIFE EXPECTANCY =              0.00012
     OUTPUT DATA BASED ON AGE INTERVAL =  0 - 110    |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =       12.29628
                                                     |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =     13.36827
----------------------------------------------------------------------------------------------------------

   CANCER                    FETAL                              CHILD                             ADULT
                  LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE      LATENCY  PLATEAU  DEATH RATE

   LIVER             0        0       0.0             15       110      1.100           15       110      0.110
----------------------------------------------------------------------------------------------------------
              CANCER                   FETAL          CHILD          ADULT            TOTAL

              LIVER                     0.0          0.52504        0.39478          0.91981
              TOTAL                     0.0          0.52504        0.39478          0.91981
----------------------------------------------------------------------------------------------------------
              TOTAL NUMBER OF INCREMENTAL DEATHS                                        0.91981
----------------------------------------------------------------------------------------------------------
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                 TOTAL POPULATION LIVER FATALITIES FROM LIFETIME CM-242 INHALATION: RELATIVE RISK

                                         POPULATION AT RISK: GENERAL
   NUMBER OF DOSE RATES: NINE                                   REFERENCE TABLE INPUT SOURCE: DISK
   RADIATION RISK MODEL: RELATIVE                                       ADDITIONAL ANALYSIS: STAGES & CANCERS
        ADDITIONAL RISK: NONE                                             ADDITIONAL OUTPUT: NONE

---------------------------------------------------------------------------------------------------------------
                 ***   INPUT DATA   ***                    |                  ***   OUTPUT DATA   ***
                                                           |
          DOSE                            AGE INTERVAL     |
           0.000275000                        0 -   2      |
           0.000464000                        2 -   8      |
           0.000532000                        8 -  12      |
           0.000596000                       12 -  17      |
           0.000660000                       17 -  22      |
           0.000766000                       22 -  35      |
           0.000848000                       35 -  45      |
           0.000911000                       45 -  60      |
           0.001000000                       60 - 110      |
       CHILD AGE INTERVAL =                   0 -  10      |  NUMBER OF PREMATURE DEATHS =                         0.75739
       ADULT AGE INTERVAL =                  10 - 110      |  DECREASE IN POPULATION LIFE EXPECTANCY =             0.00010
       OUTPUT DATA BASED ON AGE INTERVAL =    0 - 110      |  TOTAL YEARS OF LIFE LOST TO PREMATURE DEATHS =       9.84740
                                                           |  AVERAGE YEARS OF LIFE LOST PER PREMATURE DEATH =    13.00179
---------------------------------------------------------------------------------------------------------------

     CANCER                       FETAL                               CHILD                              ADULT
                      LATENCY  PLATEAU  DEATH RATE       LATENCY  PLATLAU  DEATH RATE       LATENCY  PLATEAU  DEATH RATE

     LIVER               0        0       0.0               30      110      1.100             30      110      0.110

---------------------------------------------------------------------------------------------------------------
                    CANCER                    FETAL          CHILD          ADULT             TOTAL

                    LIVER                       0.0        0.51665        0.24070           0.75739
                    TOTAL                       0.0        0.51665        0.24070           0.75739

---------------------------------------------------------------------------------------------------------------

                    TOTAL NUMBER OF INCREMENTAL DEATHS                                        0.75739

---------------------------------------------------------------------------------------------------------------
***   END OF RUN   ***
```

Reference Life Table

Male Population

$_tq_x$	l_x	T_x
0.0224500000	100000.0000000000	6705203.4960201313
0.0013298550	97755.0000000000	6606325.9960201313
0.0009423820	97625.0000244750	6508635.9960078939
0.0007689700	97532.9999817019	6411056.9960048057
0.0006464320	97458.0000307060	6313561.4959986019
0.0005749780	97395.0000608301	6216134.9959528339
0.0005444890	97339.0000784852	6118767.9958831763
0.0005139480	97286.0000636714	6021455.4958120983
0.0004627920	97236.0001185107	5924194.4957210072
0.0004115610	97191.0000755438	5826980.9956239802
0.0003499710	97151.0000503617	5729809.9955610274
0.0003500930	97117.0000177231	5632675.9955269850
0.0004120180	97083.0000358359	5535575.9955002058
0.0005873680	97043.0000923271	5438512.9954361245
0.0008454830	96986.0001394489	5341498.4953202365
0.0011351440	96904.0001250930	5244553.4951879657
0.0014153770	96794.0001307750	5147704.4950600318
0.0016760300	96657.0001292519	5050978.9949300184
0.0018446550	96495.0000973252	4954402.9948167300
0.0019830350	96317.0001129207	4857996.9947116072
0.0021118120	96126.0001306018	4761775.4945898461
0.0022622310	95923.0000900139	4665750.9944795384
0.0023509500	95706.0001055973	4569936.4943817330
0.0023564900	95481.0000846490	4474342.9942866100
0.0022675740	95256.0000627596	4378974.4942129059
0.0021675080	95040.0000336732	4283826.4941646897
0.0020667690	94834.0000732802	4188889.4941112131
0.0019865170	94638.0001017828	4094153.4940236816
0.0019798840	94450.0001057346	3999609.4939199230
0.0020262460	94263.0000617253	3905252.9938361931
0.0021047710	94072.0000349022	3811085.4937878796
0.0021837780	93874.0000173167	3717112.4937617702
0.0022739650	93669.0000413069	3623340.9937324584
0.0023968500	93456.0000136279	3529778.4937049912
0.0025205940	93231.9999999953	3436434.4936981797
0.0026775060	92996.9999801873	3343319.9937080885
0.0028895500	92747.9999547583	3250447.4937406159
0.0031141870	92479.9999714890	3157833.4937774923
0.0033842420	92191.9999578178	3065497.4938128390
0.0036895950	91879.9999194966	2973461.4938741820
0.0040091330	91540.9999311936	2881750.9939488370
0.0043433430	91173.9998875164	2790393.4940394822
0.0047368310	90777.9999333230	2699417.4941290626
0.0051799710	90347.9998891208	2608854.4942178410
0.0056853580	89879.9998697871	2518740.4943383872
0.0062325860	89368.9998934874	2429115.9944567499
0.0068121430	88811.9999159173	2340025.4945520477
0.0074370510	88206.9998723741	2251515.9946579020
0.0081209810	87550.9999157662	2163636.9947638321
0.0088668820	86839.9999089193	2076441.4948514896
0.0096781690	86069.9998768469	1989986.4949586065
0.0105939910	85236.9998722088	1904332.9950840787
0.0116086040	84333.9998626956	1819547.4952166267
0.0127526840	83354.9998545535	1735702.9953580021
0.0140110820	82291.9998815883	1652879.4954899314

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Reference Life Table (cont)

Male Population

${}_tq_x$	l_x	T_x
0.0153317150	81138.9999233034	1571163.9955874856
0.0167594970	79894.9999010943	1490646.9956752870
0.0182672230	78555.9998899369	1411421.4957797716
0.0198648880	77120.9999219594	1333582.9958738235
0.0215772140	75588.9998960617	1257227.9959648130
0.0233916550	73957.9998692584	1182454.4960821532
0.0253225900	72227.9998518266	1109361.4962216108
0.0273867530	70398.9998250588	1038047.9963831683
0.0295891690	68470.9998054028	968612.9965679375
0.0320114380	66444.9998205618	901154.9967549552
0.0346248330	64317.9998283959	835773.4969304763
0.0374611460	62090.9998254436	772568.9971035566
0.0404249980	59764.9998156967	711640.9972829864
0.0435055540	57348.9998176772	653083.9974662995
0.0466328800	54853.9998092632	596982.4976528292
0.0499273370	52295.9998186378	543407.4978388787
0.0534366510	49684.9998119408	492416.9980235894
0.0574101640	47029.9998170550	444059.4982090915
0.0619219490	44329.9998146379	398379.4983932451
0.0670434050	41584.9998269459	355421.9985724531
0.0726344820	38796.9998416230	315230.9987381687
0.0785458180	35978.9998549727	277842.9988898708
0.0846378910	33152.9998805420	243276.9990221135
0.0906844170	30346.9998903296	211526.9991366777
0.0969016130	27594.9998975760	182555.9992427249
0.1036475260	24920.9998967661	156297.9993455539
0.1112454110	22337.9999120200	132668.4994411608
0.1193270540	19852.9999308894	111572.9995197061
0.1276595750	17483.9999360742	92904.4995862244
0.1366378180	15251.9999349349	76536.4996507199
0.1473268530	13167.9999436893	62326.4997114078
0.1597791240	11227.9999516813	50128.4997637225
0.1727793090	9433.9999551296	39797.4998103170
0.1852895950	7803.9999617763	31178.4998518640
0.1967599870	6357.9999694788	24097.4998862365
0.2083414920	5106.9999781381	18364.9999124280
0.2213702700	4042.9999830489	13789.9999318345
0.2350698860	3147.9999851913	10194.4999477144
0.2500000000	2407.9999875444	7416.4999613466
0.2657807310	1805.9999906583	5309.4999722452
0.2797888390	1325.9999929551	3743.4999804385
0.2910994760	954.9999944122	2602.9999867548
0.3013293940	676.9999964588	1786.9999913193
0.3107822410	472.9999977879	1211.9999941959
0.3190184050	325.9999984824	812.4999960608
0.3288288290	221.9999989365	538.4999973514
0.3355704700	148.9999992482	352.9999982590
0.3434343430	98.9999994705	228.9999988996
0.3538461540	64.9999996953	146.9999993167
0.3571428570	41.9999997931	93.4999995725
0.3703703700	26.9999998730	58.9999997394
0.3529411770	16.9999999301	36.9999998378
0.3636363640	10.9999999457	22.9999998999
0.4285714290	6.9999999615	13.9999999463
0.2500000000	3.9999999750	8.4999999781
0.0	0.0	5.0

Reference Life Table

Female Population

${}_tq_x$	l_x	T_x
0.0174600000	100000.0000000000	7465024.1789402708
0.0011704360	98254.0000000000	7365897.1789402708
0.0007642220	98138.9999812560	7267700.6789496429
0.0006016480	98063.9999984123	7169599.1789598088
0.0005101780	98004.9999889413	7071564.6789661320
0.0004287680	97954.9999940569	6973584.6789746331
0.0003778860	97913.0000246194	6875650.6789652950
0.0003473780	97876.0000726921	6777756.1789166392
0.0003066170	97842.0001035389	6679897.1788285237
0.0002862630	97812.0000829931	6582070.1787352578
0.0002556650	97784.0001264134	6484272.1786305546
0.0002557310	97759.0001800210	6386500.6784773376
0.0002762600	97734.0001731460	6288754.1783007542
0.0003172750	97707.0001782582	6191033.6781250522
0.0004095170	97676.0001897766	6093342.1779410350
0.0004916220	97636.0002072069	5995686.1777425434
0.0005840880	97588.0002015130	5898074.1775381835
0.0006562020	97531.0002216513	5800514.6773266015
0.0006874120	97467.0001842438	5703015.6771236539
0.0007084190	97400.0001987132	5605582.1769321756
0.0007191950	97331.0001879724	5508216.6767388331
0.0007299950	97261.0002192922	5410920.6765352008
0.0007511060	97190.0001754371	5313695.1763378363
0.0007722640	97117.0001831653	5216541.6761585353
0.0007831660	97042.0002201359	5119462.1759568849
0.0008044060	96966.0002249915	5022458.1757343214
0.0008360170	96888.0001926145	4925531.1755255186
0.0008573760	96807.0001773574	4828683.6753405328
0.0009098050	96724.0001787734	4731918.1751624674
0.0009520260	96636.0001997907	4635238.1749731854
0.0010254390	96544.0002150645	4538648.1747657580
0.0010990720	96445.0002320280	4442153.6745422119
0.0011937010	96339.0002327330	4345761.6743098316
0.0012782670	96224.0002718161	4249480.1740575572
0.0014047720	96101.0003076607	4153317.6737678188
0.0015109520	95966.0003132565	4057284.1734573604
0.0016593440	95821.0002931512	3961390.6731541567
0.0017979970	95662.0002912407	3865649.1728619609
0.0019687920	95490.0003017031	3770073.1725654891
0.0021510570	95302.0003530291	3674677.1722381231
0.0023239430	95097.0003180557	3579477.6719025809
0.0025190770	94876.0003098455	3484491.1715886304
0.0027262060	94637.0003596130	3389734.6712539012
0.0029773570	94379.0004014106	3295226.6708733896
0.0032413020	94098.0004239124	3200988.1704607282
0.0035397100	93793.0003869424	3107042.6700553009
0.0038518740	93461.0003655427	3013415.6696790585
0.0041567760	93101.0003682207	2920134.6693121768
0.0044761310	92714.0003643141	2827227.1689459095
0.0048429560	92299.0003531494	2734720.6685871778
0.0052257980	91852.0003555951	2642645.1682328056
0.0056581880	91372.0003558408	2551033.1678770878
0.0061086350	90855.0003998914	2459919.6674992219
0.0066002210	90300.0003645236	2369342.1671170145
0.0071122800	89704.0004058177	2279340.1667318440

Reference Life Table (cont)

Female Population

$_tq_x$	l_x	T_x
0.0076796980	89066.0004378114	2189955.1663100296
0.0082935440	88382.0004523811	2101231.1658649335
0.0089447680	87649.0004428213	2013215.6654173324
0.0096126170	86865.0004684283	1925958.6649617078
0.0103568520	86030.0004882205	1839511.1644833835
0.0111347330	85139.0005056041	1753926.6639864712
0.0119965320	84191.0004670873	1669261.6635001258
0.0129837340	83181.0004358719	1585575.6630486462
0.0141045780	82101.0004523586	1502934.6626045310
0.0153811940	80943.0004876003	1421412.6621345517
0.0167758290	79698.0004941584	1341092.1616436725
0.0183126810	78361.0004662265	1262062.6611634803
0.0200452380	76926.0004618476	1184419.1606994432
0.0219409950	75384.0004742018	1108264.1602314187
0.0240743250	73730.0004967173	1033707.1597459592
0.0263220070	71955.0005025092	960864.6592463459
0.0287891980	70061.0004755971	889856.6587572927
0.0316559870	68044.0004608271	820804.1582890806
0.0350280770	65890.0004668111	753837.1578252615
0.0389261110	63582.0004569296	689101.1573633911
0.0432520010	61107.0004495411	626756.6569101558
0.0478927200	58464.0004049906	566971.1564828899
0.0529426560	55664.0004035145	509907.1560786374
0.0584062070	52717.0003785674	455716.6556875964
0.0643257180	49638.0003420377	404539.1553272939
0.0709656580	46445.0003299519	356497.6549912992
0.0783332170	43149.0003207266	311700.6546659600
0.0861223570	39769.0003152701	270241.6543479616
0.0941833590	36344.0002725853	232185.1540540340
0.1027611550	32921.0002474163	197552.6537940332
0.1128038460	29538.0002382365	166323.1535512069
0.1246279480	26206.0002082145	138451.1533279814
0.1368352220	22940.0001769771	113878.1531353856
0.1486288570	19801.0001600804	92507.6529668568
0.1600427100	16858.0001388309	74178.1528174011
0.1726694910	14160.0001114320	58669.1526922697
0.1871105420	11715.0000996311	45731.6525867382
0.2024572090	9523.0000814591	35112.6524961931
0.2175115210	7595.0000636601	26553.6524236335
0.2318694260	5943.0000478183	19784.6523678943
0.2457831320	4565.0000380127	14530.6523249789
0.2584954980	3443.0000310898	10526.6522904276
0.2698785740	2553.0000234392	7528.6522631631
0.2800429180	1864.0000176915	5320.1522425977
0.2891207150	1342.0000135851	3717.1522269594
0.2987421380	954.0000101274	2569.1522151032
0.3064275040	669.0000074499	1757.6522063146
0.3146551720	464.0000049910	1191.1522000941
0.3207547170	318.0000036126	800.1521957923
0.3287037040	216.0000024478	533.1521927621
0.3310344830	145.0000015792	352.6521907485
0.3302061860	97.0000010214	231.6521894482
0.3437500000	64.9700006422	150.6671886164
0.3571428570	42.6365629214	96.8639068346
0.3333333330	27.4092190270	61.8410158604
0.0	0.0	39.0

Reference Life Table

Total Population

$_tq_x$	l_x	T_x
0.0200200000	100000.0000000000	7075647.4998189092
0.0012449230	97998.0000000000	6976648.4998189092
0.0008582290	97876.0000358460	6878711.4998009864
0.0006953530	97792.0000142112	6780877.4997759578
0.0005730420	97724.0000536253	6683119.4997420397
0.0005017000	97668.0000971866	6585423.4996666338
0.0004712200	97619.0000615378	6487779.9995872716
0.0004304470	97573.0000363288	6390183.9995383383
0.0003793670	97531.0000311822	6292631.9995045830
0.0003487390	97493.9999882933	6195119.4994948453
0.0003078190	97460.0000282314	6097642.4994865831
0.0002976500	97429.9999884827	6000197.4994782261
0.0003490720	97400.9999489862	5902781.9995094917
0.0004621690	97366.9999871319	5805397.9995414328
0.0006267850	97321.9999781149	5708053.4995588094
0.0008225290	97261.0000083586	5610761.9995655727
0.0010084280	97181.0000152827	5513540.9995537521
0.0011639520	97082.9999737993	5416408.9995592113
0.0012787460	96970.0000218138	5319382.4995614048
0.0013423370	96846.0000221659	5222474.4995394151
0.0014061790	96716.0000530341	5125693.4995018153
0.0014702840	96580.0000447955	5029045.4994529006
0.0015139260	96438.0000160097	4932536.4994224980
0.0015266070	96292.0000203974	4836171.4994042946
0.0015031390	96144.9999791223	4739952.9994045349
0.0014687500	95999.9999549988	4643880.4994374744
0.0014396140	95858.9999550648	4547950.9994824426
0.0014103490	95720.9999967035	4452160.9995065585
0.0014437260	95585.9999800792	4356507.4995181672
0.0014772440	95447.9999366719	4260990.4995347918
0.0015633690	95307.0000013796	4165612.9995407662
0.0016288700	95157.9999920945	4070380.4995440294
0.0017157350	95002.9999806473	3975299.9995576586
0.0018346690	94840.0000084755	3880378.4995630973
0.0019436760	94666.0000005000	3785625.4995586097
0.0020850530	94481.9999682830	3691051.4995742184
0.0022485020	94284.9999908031	3596667.9995946754
0.0024449100	94072.9999797538	3502488.9996093970
0.0026640240	93842.9999613733	3408530.9996388336
0.0028955160	93592.9999572442	3314812.9996795249
0.0031503820	93321.9999283800	3221355.4997367130
0.0033968270	93027.9999796016	3128180.4997827224
0.0037104150	92711.9999575149	3035310.4998141644
0.0040381950	92367.9999621925	2942770.4998543109
0.0044350240	91994.9999665852	2850588.9998899221
0.0048369310	91586.9999338533	2758797.9999397029
0.0052883350	91143.9999346763	2667432.5000054382
0.0057355890	90661.9999297817	2576529.5000732094
0.0062457010	90141.9999602665	2486127.5001281854
0.0067761420	89578.9999809726	2396267.0001575660
0.0073843460	88971.9999568835	2306991.5001886380
0.0080394040	88314.9999248899	2218348.0002477514
0.0087552080	87604.9999612337	2130388.0003046896
0.0095695430	86837.9999647331	2043166.5003417062
0.0104293840	86006.9999900366	1956744.0003643215

Reference Life Table (cont)

Total Population

$_tq_x$	l_x	T_x
0.0113735170	85109.9999604525	1871185.5003890770
0.0123481730	84141.9999290323	1786559.5004443347
0.0134170850	83102.9999573426	1702937.0005011472
0.0145143190	81987.9999431600	1620391.5005508962
0.0157058340	80797.9999578130	1538998.5006004099
0.0169497920	79528.9999829435	1458835.0006300318
0.0182908890	78180.9999752646	1379980.0006509279
0.0197391560	76750.9999828080	1302514.0006718917
0.0213328730	75236.0000209914	1226520.5006699921
0.0230609390	73630.9999875156	1152087.0006657387
0.0249398750	71932.9999882945	1079305.0006778338
0.0269892640	70138.9999602114	1008269.0007035810
0.0291885240	68245.9999735893	939076.5007366807
0.0315150780	66253.9999654562	871826.5007671580
0.0340055480	64165.9999887328	806616.5007900635
0.0366062210	61983.9999961480	743541.5007976232
0.0394373270	59714.9999938250	682692.0008026367
0.0426603900	57360.0000122635	624154.5007995925
0.0464370910	54913.0000413403	568018.0007727906
0.0507610340	52363.0000613376	514380.0007214517
0.0555074940	49705.0000348820	463346.0006733418
0.0606015420	46946.0000436758	415020.5006340629
0.0659622230	44101.0000502970	369497.0005870765
0.0715430180	41192.0000504563	326850.5005366999
0.0773957380	38245.0000493905	287132.0004867765
0.0839450190	35285.0000457579	250367.0004392023
0.0912044050	32323.0000465017	216563.0003930725
0.0989276600	29375.0000594456	185714.0003400988
0.1069553060	26469.0000410648	157792.0002898437
0.1154920040	23638.0000421587	132738.5002482320
0.1255978570	20908.0000467377	110465.5002037838
0.1374576090	18282.0000467115	90870.5001570592
0.1497875580	15769.0000325527	73845.0001174271
0.1616319830	13407.0000255747	59257.0000883634
0.1728647690	11240.0000253600	46933.5000628961
0.1850059160	9297.0000174161	36665.0000415080
0.1988913820	7577.0000131421	28228.0000262289
0.2136738060	6070.0000091142	21404.5000151008
0.2285774150	4773.0000047467	15983.0000081703
0.2433460080	3682.0000018667	11755.5000048635
0.2577171570	2785.9999999565	8521.5000039519
0.2693423600	2068.0000005657	6094.5000036908
0.2806088680	1510.9999999333	4305.0000034413
0.2897884080	1087.0000004040	3006.0000032726
0.2979274610	772.0000007910	2076.5000026751
0.3081180810	542.0000006633	1419.5000019480
0.3146666670	375.0000005569	961.0000013379
0.3190661480	257.0000002567	645.0000009311
0.3314285710	175.0000001388	429.0000007334
0.3333333330	117.0000001678	283.0000005801
0.3333333330	78.0000001509	185.5000004208
0.3461538460	52.0000001266	120.5000002820
0.3529411760	34.0000000908	77.5000001734
0.3636363640	22.0000000747	49.5000000906
0.3571428570	14.0000000396	31.5000000335
0.0	0.0	20.0

Cancer Mortality Data (Abridge Format)

```
....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
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Leukemia

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000031184 000035367 000021347 000020230 000016544 000016845 000021854 000028818
000035454 000043871 000062375 000100071 000140089 000225118 000348896 000467433
000590830 000740834 000740834 000740834 000740834 000740834
```

All Other Cancers

```
000037031 000032554 000032216 000052229 000071318 000110853 000196325 000389229
000758201 001319668 002196321 003419671 004864605 006583333 008509686 010022733
011596836 014124127 014124127 014124127 014124127 014124127
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Lung

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000000028 000000019 000000044 000000060 000000184 000000357 000001579 000005845
000015225 000029732 000054034 000083539 000125791 000157406 000176327 000157369
000128237 000106327 000106327 000106827 000106827 000106327
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Liver

```
000001559 000000244 000000341 000000596 000000951 000000911 000001606 000002161
000004142 000009443 000016937 000028380 000038272 000051530 000060442 000066922
000068339 000071373 000071373 000071373 000071373 000071373
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FORTRAN IV G1  RELEASE 2.0              MAIN                DATE = 78193          13/44/22                PAGE 0001
                C                                                                        00000100
                C     *** COHORT ANALYSIS FOR INCREASED RISK OF DEATH  ***               00000200
                C                                                                        00000300
                C     ...DECLARATION, DIMENSION AND INITIALIZATION OF SCALARS AND ARRAYS00000400
                C                                                                        00000500
 0001                REAL*8 REFTBL(111,3,3)/999*0.0/,MORT(22,3,11)/726*0.0/,ALLCAN      00000600
                    1(111,4,11)/4884*0.0/,GLTABL(111,9)/999*0.0/,ARCO(111)/111*0.0/,    00000700
                    2NOARCO(111)/111*0.0/,TDEAD(111)/111*0.0/,FETAL(111)/111*0.0/,      00000800
                    3CHILD(111)/111*0.0/,ADULT(111)/111*0.0/,MORTAL(22)/22*0.0/,        00000900
                    4CANMOR(111,10)/1110*1.0/,DOSE(9),FDEATH,CDEATH(10),ADEATH(10),     00001000
                    5INCMOR,REFMOR                                                      00001100
                C                                                                        00001200
 0002                REAL*8 LSW1(3)/'MALE','FEMALE','GENERAL'/,LSW2(2)/'DISK','CARDS'/,00001300
                    1LSW3(3)/'NONE','ABSOLUTE','RFLATIVE'/,LSW4(4,5)/'NONE',' ',' ',    00001400
                    2' ','ACCIDENT',' (SINGLE',')',' ','ACCIDENT',' MULTIP','LE)',' ', 00001500
                    3'CANCER C','OMMITTME','NT (SING','LE)','CANCER C','OMMITTME',      00001600
                    4'NT (MULT','IPLE)'/,LSW5(2,4)/'NONE',' ','STAGES',' ','CANCERS',   00001700
                    5' ','STAGES &',' CANCERS'/,LSW6(3,4)/'NONE',' ',' ','LIFE TAB'     00001800
                    6,'LE',' ','COMPONEN','T ANALYS','IS','LIFE TAB','LE & ANA',        00001900
                    7'LYSIS'/,LSW7(10)/'NONE','ONE','TWO','THREE','FOUR','FIVE','SIX', 00002000
                    8'SEVEN','EIGHT','NINE'/                                            00002100
                C                                                                        00002200
 0003                REAL*4 TITLE(20),CANCER(3,10)                                      00002300
                C                                                                        00002400
 0004                INTEGER*4 INTAGE(110,2),BEGAGE(9),ENDAGE(9),STRTAG(9),CLTNCY(9),   00002500
                    1CPLATO(9),ALTNCY(9),APLATO(9),KIDEXP(9),ADEXP(9),SWITCH(7),        00002600
                    2AGE,CAN,POP,REF,STG,SEPAGE,STATRF,TOTCAN,CANNO,BEGSTG,BEGCAN,      00002700
                    3SW1,SW2,SW3,SW4,SW5,SW6,SW7,CASREP,CANREP                          00002800
                C                                                                        00002900
 0005                EQUIVALENCE (SW1,SWITCH(1)),(SW2,SWITCH(2)),(SW3,SWITCH(3)),       00003000
                    1(SW4,SWITCH(4)),(SW5,SWITCH(5)),(SW6,SWITCH(6)),(SW7,SWITCH(7))    00003100
                C                                                                        00003200
                C     ...INPUT CASE PARAMETERS - DETERMINE END OF RUN                    00003300
                C                                                                        00003400
 0006              5 READ(5,7)TITLE                                                      00003500
 0007              7 FORMAT(20A4)                                                        00003600
 0008                WRITE(6,7)TITLE                                                     00003700
 0009                READ(5,17,END=15)(SWITCH(I),I=1,7),NOCAN,SEPAGE,NORMAG,             00003800
                    1(BEGAGE(J),J=1,9),(ENDAGE(J),J=1,9),(DOSE(J),J=1,9)                 00003900
 0010             17 FORMAT(7I1,3X,12I5,/,9I5,3F10.9,/,6F10.9)                           00004000
 0011                IF(SW1.EQ.0)GO TO 15                                                00004100
 0012                TOTCAN = NOCAN + 1                                                  00004200
                C                                                                        00004300
                C     ...INPUT REFERENCE LIFE TABLE DATA FROM DISK OR CARDS              00004400
                C                                                                        00004500
 0013                IF(SW2.NE.1)GO TO 25                                                00004600
 0014                READ(8,27)(((REFTBL(AGE,REF,POP),REF=1,3),AGE=1,111),POP=1,3)       00004700
 0015             27 FORMAT(3F20.10)                                                     00004800
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 0016                 REWIND 8                                                                 00004900
 0017                 GO TO 35                                                                 00005000
 0018              25 READ(5,37)(((REFTBL(AGE,REF,POP),REF=1,3),AGE=1,111),POP=1,3)            00005100
 0019              35 IF(SW3.EQ.1)GO TO 45                                                     00005200
               C                                                                               00005300
               C      ...CALCULATION AND STORAGE OF STAGE RISK FOR CANCERS                     00005400
               C                                                                               00005500
 0020                 DO 10  CAN=1,NOCAN                                                       00005600
               C                                                                               00005700
               C        ...INPUT STAGE LATENCY, PLATEAU, AND RISK RATE DATA FOR CANCERS        00005800
               C                                                                               00005900
 0021                   READ(5,37)CASREP,CANREP,CANNO,(CANCER(K,CAN),K=1,3),FLTNCY,            00006000
                    1   FPLATO,FDEATH,CLTNCY(CAN),CPLATO(CAN),CDEATH(CAN),ALTNCY(CAN),         00006100
                    2   APLATO(CAN),ADEATH(CAN)                                                00006200
 0022              37   FORMAT(I1,I1,I3,5X,3A4,3X,2I5,F5.0,2I5,F5.0,2I5,F5.0)                  00006300
               C                                                                               00006400
               C                                                                               00006500
               C        ...INPUT ABRIDGED CANCER MORTALITY DATA                                00006600
               C                                                                               00006700
 0023                   IF(SW3.NE.3)GO TO 55                                                   00006800
 0024                   IF(CANREP.NE.1)GO TO 55                                                00006900
 0025                   READ(5,47)(MORTAL(L),L=1,22)                                           00007000
 0026              47   FORMAT(8F10.9)                                                         00007100
               C                                                                               00007200
               C        ...EXPAND ABRIDGED CANCER MORTALITY DATA TO LIFE TABLE FORMAT          00007300
               C                                                                               00007400
 0027                   DO 20 L=1,22                                                           00007500
 0028                     AGE = 5 * (L-1) + 1                                                  00007600
 0029              65     CANMOR(AGE,CAN) = MORTAL(L)                                          00007700
 0030                     IF(AGE.EQ.5*L)GO TO 20                                               00007800
 0031                     AGE = AGE + 1                                                        00007900
 0032                     GO TO 65                                                             00008000
 0033              20   CONTINUE                                                               00008100
               C                                                                               00008200
               C      ...CALCULATE RADIATION RISK DISTRIBUTION FOR ALL CASE DOSES              00008300
               C                                                                               00008400
 0034              55   DO 30 J=1,SW7                                                          00008500
 0035                     IF(BEGAGE(J).NE.-1)GO TO 75                                          00008600
 0036                     CALL FETRSK(SWITCH(3),FLTNCY,FPLATO,DOSE(1),FDEATH,FETAL)            00008700
 0037                     GO TO 30                                                             00008800
 0038              75     IF(BEGAGE(J).LT.SEPAGE)GO TO 85                                      00008900
 0039                     STRTAG(J) = BEGAGE(J)                                                00009000
 0040                     ADEXP(J) = ENDAGE(J) - STRTAG(J)                                     00009100
 0041                     CALL CARSK(SWITCH(3),STRTAG(J),ADEXP(J),DOSE(J),ALTNCY(CAN),         00009200
                    1     APLATO(CAN),ADEATH(CAN),ADULT)                                       00009300
 0042                     GO TO 30                                                             00009400
 0043              85     IF(ENDAGE(J).LT.SEPAGE)GO TO 95                                      00009500
 0044                     KIDEXP(J) = SEPAGE - BEGAGE(J)                                       00009600
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0045                 CALL CARSK(SWITCH(3),BEGAGE(J),KIDEXP(J), DOSE(J),CLTNCY(CAN),00009700
                    1    CPLATO(CAN),CDEATH(CAN),CHILD)
0046                 STRTAG(J) = SEPAGE                                           00009800
0047                 ADEXP(J) = ENDAGE(J) - SEPAGE                                00009900
0048                 CALL CARSK(SWITCH(3),STRTAG(J),ADEXP(J),DOSE(J),ALTNCY(CAN),  00010000
                    1    APLATO(CAN),ADEATH(CAN),ADULT)                           00010100
0049                 GO TO 30                                                     00010200
0050            95   KIDEXP(J) = ENDAGE(J) - BEGAGE(J)                            00010300
0051                 CALL CARSK(SWITCH(3),BEGAGE(J),KIDEXP(J), DOSE(J),CLTNCY(CAN),00010400
                    1    CPLATO(CAN),CDEATH(CAN),CHILD)                           00010500
0052          30   CONTINUE                                                       00010600
              C                                                                   00010700
              C       ...STORE FETAL, CHILD, ADULT AND SUMMED RISKS FOR ALL AGES  00010800
              C          - CALCULATE RADIATION MORTALITY FOR RELATIVE RISK CASES  00010900
              C                                                                   00011000
0053                 DO 40  AGE=1,110                                             00011100
0054                   ALLCAN(AGE,1,CAN) = ALLCAN(AGE,1,CAN) + FETAL(AGE) *       00011200
                    1    CANMOR(AGE,CAN)                                          00011300
0055                   ALLCAN(AGE,2,CAN) = ALLCAN(AGE,2,CAN) + CHILD(AGE) *       00011400
                    1    CANMOR(AGE,CAN)                                          00011500
0056                   ALLCAN(AGE,3,CAN) = ALLCAN(AGE,3,CAN) + ADULT(AGE) *       00011600
                    1    CANMOR(AGE,CAN)                                          00011700
0057                   ALLCAN(AGE,4,CAN) = ALLCAN(AGE,4,CAN) + (FETAL(AGE) +      00011800
                    1    CHILD(AGE) + ADULT(AGE)) * CANMOR(AGE,CAN)               00011900
              C                                                                   00012000
              C         ...STORE TOTAL RADIATION RISK FOR ALL AGES                00012100
              C                                                                   00012200
0058                   DO 50 STG=1,4                                              00012300
0059                     ALLCAN(AGE,STG,TOTCAN) = ALLCAN(AGE,STG,TOTCAN) +        00012400
                    1      ALLCAN(AGE,STG,CAN)                                    00012500
0060            50     CONTINUE                                                   00012600
0061            40   CONTINUE                                                     00012700
              C                                                                   00012800
              C       ...INITIALIZE STAGE VECTORS FOR NEXT CANCER                 00012900
              C                                                                   00013000
0062                 DO 60 AGE=1,111                                              00013100
0063                   FETAL(AGE) = 0.0                                           00013200
0064                   CHILD(AGE) = 0.0                                           00013300
0065                   ADULT(AGE) = 0.0                                           00013400
0066            60   CONTINUE                                                     00013500
0067            10 CONTINUE                                                       00013600
              C                                                                   00013700
              C     ...DETERMINE TYPE AND FORMAT OF ADDITIONAL RISK               00013800
              C                                                                   00013900
0068            45 GO TO(105,115,115,125,125),SW4                                 00014000
              C                                                                   00014100
              C     ...INPUT NON-RADIATION RISK VALUES - THESE RISKS ARE NOT SUBJECT 00014200
              C        MORTALITY CONVERSION                                       00014300
                                                                                  00014400
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                   C                                                                        00014500
 0069                115  CALL ACCRSK(SW4,BEGAGE(1),ENDAGE(1),CASREP,NOARCO)                 00014600
 0070                     GO TO 105                                                         00014700
                   C                                                                        00014800
                   C      ...INPUT NON-RADIATION RISK VALUES - THESE RISKS ARE SUBJECT TO   00014900
                   C     1   MORTALITY CONVERSION                                           00015000
                   C                                                                        00015100
 0071                125  CALL ACCRSK(SW4,BEGAGE(1),ENDAGE(1),CASREP,ARCO)                   00015200
                   C                                                                        00015300
                   C      ...GENERATE LIFE TABLE                                            00015400
                   C                                                                        00015500
 0072                105  STATRF = NORMAG + 1                                               00015600
 0073                     GLTABL(STATRF,4) = REFTBL(STATRF,2,SW1)                           00015700
 0074                     ADDEAD = 0.0                                                      00015800
 0075                     DO 70 AGE=STATRF,110                                              00015900
 0076                       INTAGE(AGE,2) = AGE                                             00016000
 0077                       INTAGE(AGE,1) = INTAGE(AGE,2) - 1                               00016100
 0078                       REFMOR = REFTBL(AGE,1,SW1) / (1.0-0.5*REFTBL(AGE,1,SW1))        00016200
 0079                       GLTABL(AGE,2) = ARCO(AGE)                                       00016300
 0080                       GLTABL(AGE,2) = GLTABL(AGE,2) / (1.0-0.5*GLTABL(AGE,2))         00016400
 0081                       INCMOR = GLTABL(AGE,2) + ALLCAN(AGE,4,TOTCAN) + NOARCO(AGE)     00016500
 0082                       GLTABL(AGE,1) = REFMOR / (1.0+0.5*(REFMOR + INCMOR))            00016600
 0083                       GLTABL(AGE,2) = INCMOR / (1.0+0.5*(REFMOR + INCMOR))            00016700
 0084                       GLTABL(AGE,3) = GLTABL(AGE,1) + GLTABL(AGE,2)                   00016800
 0085                       GLTABL(AGE,5) = GLTABL(AGE,3) * GLTABL(AGE,4)                   00016900
 0086                       GLTABL(AGE+1,4) = GLTABL(AGE,4) - GLTABL(AGE,5)                 00017000
 0087                       GLTABL(AGE,6) = (GLTABL(AGE,4)+GLTABL(AGE+1,4)) / 2.            00017100
 0088                       GLTABL(AGE,9) = GLTABL(AGE,2) * GLTABL(AGE,4)                   00017200
 0089                       ADDEAD = ADDEAD + GLTABL(AGE,9)                                 00017300
 0090                 70  CONTINUE                                                          00017400
 0091                     ADDEAD = ADDEAD * (100000.0/REFTBL(STATRF,2,SW1))                 00017500
 0092                     AGE = 110                                                         00017600
 0093                     GLTABL(AGE,7) = GLTABL(AGE,6) + REFTBL(111,3,SW1)                 00017700
 0094                     GLTABL(AGE,8) = GLTABL(AGE,7) / GLTABL(AGE,4)                     00017800
 0095                135  AGE = AGE - 1                                                     00017900
 0096                     GLTABL(AGE,7) = GLTABL(AGE,6) + GLTABL(AGE+1,7)                   00018000
 0097                     GLTABL(AGE,8) = GLTABL(AGE,7) / GLTABL(AGE,4)                     00018100
 0098                     IF(AGE.GT.STATRF)GO TO 135                                        00018200
                   C                                                                        00018300
                   C      ...DETERMINE TYPE OF ADDITIONAL ANALYSIS AND ASSIGN ORGAN AND STAG00018400
                   C                                                                        00018500
 0099                     GO TO(145,155,165,175),SW5                                        00018600
 0100                155  BEGCAN = TOTCAN                                                   00018700
 0101                     BEGSTG = 1                                                        00018800
 0102                     GO TO 145                                                         00018900
 0103                165  BEGCAN = 1                                                        00019000
 0104                     BEGSTG = 4                                                        00019100
 0105                     GO TO 145                                                         00019200
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0106            175  BEGCAN = 1                                                     00019300
0107                 BEGSTG = 1                                                     00019400
                C                                                                   00019500
                C      ...CALCULATE FRACTION OF TOTAL DEATHS FOR ALL AGES           00019600
                C                                                                   00019700
0108            145  DO 80 AGE=STATRF,111                                           00019800
0109                   IF(GLTABL(AGE,9).EQ.0.0)GO TO 80                             00019900
0110                   GO TO(185,195,195,205,205),SW4                               00020000
0111            185    TDEAD (AGE) = GLTABL(AGE,9)                                  00020100
0112                   GO TO 215                                                    00020200
0113            195    NOARCO(AGE) = NOARCO(AGE) * GLTABL(AGE,4)                    00020300
0114                   NOARCO(111) = NOARCO(111) + NOARCO(AGE)                      00020400
0115                   TDEAD(AGE) = GLTABL(AGE,9) - NOARCO(AGE)                     00020500
0116                   GO TO 215                                                    00020600
0117            205    ARCO(AGE) = (ARCO(AGE)*GLTABL(AGE,9)) / (ALLCAN(AGE,4,TOTCAN)+ 00020700
                    1  ARCO(AGE))                                                   00020800
0118                   ARCO(111) = ARCO(111) + ARCO(AGE)                            00020900
0119                   TDEAD(AGE) = GLTABL(AGE,9) - ARCO(AGE)                       00021000
                C                                                                   00021100
                C        ...CALCULATE AND STORE FRACTION OF TOTAL DEATHS FOR EACH CANCER 00021200
                C                                                                   00021300
0120            215    IF(SW3.EQ.1)GO TO 80                                         00021400
0121                   DO 90 CAN=BEGCAN,TOTCAN                                      00021500
                C                                                                   00021600
                C          ...CALCULATE AND STORE FRACTION OF TOTAL DEATHS FOR EACH STAGE00021700
                C                                                                   00021800
0122                     DO 100 STG=BEGSTG,4                                        00021900
0123                       ALLCAN(AGE,STG,CAN) = (ALLCAN(AGE,STG,CAN)*TDEAD(AGE) /  00022000
                    1      ALLCAN(AGE,4,TOTCAN))                                    00022100
0124                       ALLCAN(111,STG,CAN) = ALLCAN(111,STG,CAN) +              00022200
                    1      ALLCAN(AGE,STG,CAN)                                      00022300
0125            100      CONTINUE                                                   00022400
0126             90    CONTINUE                                                     00022500
0127             80  CONTINUE                                                       00022600
                C                                                                   00022700
                C      ...CALCULATE YEARS OF LIFE LOST AND DECREASE IN LIFE EXPECTANCY  00022800
                C                                                                   00022900
0128                 YLL = (REFTBL(STATRF,3,SW1)-GLTABL(STATRF,7)) * (100000.0/     00023000
                    1REFTBL(STATRF,2,SW1))                                          00023100
0129                 AVGYLL = YLL / ADDEAD                                          00023200
0130                 DLE = YLL / 100000.0                                           00023300
                C                                                                   00023400
                C      ...OUTPUT TITLE AND CASE PARAMETERS                          00023500
                C                                                                   00023600
0131                 WRITE(6,296)                                                   00023700
0132            296  FORMAT(1H1,'  ')                                               00023800
0133            475  WRITE(6,6)                                                     00023900
0134              6  FORMAT(1H ,T2,'|-----------------------------------------------',00024000
                  1'-----------------------------------------------------------------',00024100
                  2'--------------------|')                                            00024200
 0135               WRITE(6,16)                                                        00024300
 0136            16 FORMAT(1H ,T2,'|',T133,'|')                                        00024400
 0137               WRITE(6,26)TITLE                                                   00024500
 0138            26 FORMAT(1H ,T2,'|',T27,20A4,T133,'|')                               00024600
 0139               WRITE(6,16)                                                        00024700
 0140               WRITE(6,36)LSW1(SW1)                                               00024800
 0141            36 FORMAT(1H ,T2,'|',T54,'POPULATION AT RISK: ',A8,T133,'|')          00024900
 0142               WRITE(6,46)LSW7(SW7+1),LSW2(SW2)                                   00025000
 0143            46 FORMAT(1H ,T2,'|',T7,'NUMBER OF DOSE RATES: ',A8,T79,'REFERENCE ',00025100
                  1'TABLE INPUT SOURCE: ',A8,T133,'|')                                 00025200
 0144               WRITE(6,56)LSW3(SW3),(LSW5(L,SW5),L=1,2)                           00025300
 0145            56 FORMAT(1H ,T2,'|',T7,'RADIATION RISK MODEL: ',A8,T88,'ADDITION',   00025400
                  1'AL ANALYSIS: ',2A8,T133,'|')                                       00025500
 0146               WRITE(6,66)(LSW4(L,SW4),L=1,4),(LSW6(L,SW6),L=1,3)                 00025600
 0147            66 FORMAT(1H ,T2,'|',T12,'ADDITIONAL RISK: ',4A8,T90,'ADDITIONAL ',   00025700
                  1'OUTPUT: ',3A8,T133,'|')                                            00025800
 0148               WRITE(6,16)                                                        00025900
 0149               WRITE(6,6)                                                         00026000
 0150               WRITE(6,386)                                                       00026100
 0151           386 FORMAT(1H ,T2,'|',T67,'|',T133,'|')                                00026200
 0152               WRITE(6,76)                                                        00026300
 0153            76 FORMAT(1H ,T2,'|',T23,'***   INPUT DATA   ***',T67,'|',T90,'***', 00026400
                  1'   OUTPUT DATA   ***',T133,'|')                                    00026500
 0154               WRITE(6,386)                                                       00026600
                C                                                                      00026700
                C   ...OUTPUT CASE VARIABLES AND STATISTICS                            00026800
                C                                                                      00026900
 0155               WRITE(6,86)                                                        00027000
 0156            86 FORMAT(1H ,T2,'|',T15,'DOSE',T46,'AGE INTERVAL'       ,T67,'|',   00027100
                  1T133,'|')                                                           00027200
 0157               DO 120 M=1,SW7                                                     00027300
 0158                 WRITE(6,96)DOSE(M),BEGAGE(M),ENDAGE(M)                           00027400
 0159            96   FORMAT(1H ,T2,'|',T12,F15.9,T47,I3,T51,'-',T53,I3,T67,'|',T133, 00027500
                  1  '|')                                                              00027600
 0160           120 CONTINUE                                                           00027700
 0161               WRITE(6,106)SEPAGE,ADDEAD                                          00027800
 0162           106 FORMAT(1H ,T2,'|',T11,'CHILD AGE INTERVAL =',T49,'0 -',T53,I3,T67,00027900
                  1'|',T71,'NUMBER OF PREMATURE DEATHS = ',T121,F11.5,T133,'|')        00028000
 0163               WRITE(6,116)SEPAGE,DLE                                             00028100
 0164           116 FORMAT(1H ,T2,'|',T11,'ADULT AGE INTERVAL =',T47,I3,' - 110',      00028200
                  1T67,'|',T71,'DECREASE IN POPULATION LIFE EXPECTANCY =',T121,F11.5,00028300
                  2T133,'|')                                                           00028400
 0165               WRITE(6,126)NORMAG,YLL                                             00028500
 0166           126 FORMAT(1H ,T2,'|',T11,'OUTPUT DATA BASED ON AGE INTERVAL =',T47,  00028600
                  1I3,' - 110',T67,'|',T71,'TOTAL YEARS OF LIFE LOST TO PREMATURE ', 00028700
                  2'DEATHS =   ',F12.5,T133,'|')                                       00028800
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0167                  WRITE(6,136)AVGYLL                                                     00028900
0168            136   FORMAT(1H ,T2,'|',T67,'|',T71,'AVERAGE YEARS OF LIFE LOST PER',        00029000
                     1' PREMATURE DEATH = ',F12.5,T133,'|')                                  00029100
0169                  WRITE(6,146)                                                           00029200
0170            146   FORMAT(1H ,T2,'|',T67,'|',T133,'|')                                    00029300
0171                  WRITE(6,6)                                                             00029400
0172                  WRITE(6,16)                                                            00029500
0173                  IF(SW3.EQ.1)GO TO 485                                                  00029600
                C                                                                            00029700
                C     ...OUTPUT CANCER VARIABLES                                             00029800
                C                                                                            00029900
0174                  WRITE(6,16)                                                            00030000
0175                  WRITE(6,156)                                                           00030100
0176            156   FORMAT(1H ,T2,'|',T9,'CANCER ',T42,'FETAL',T75,'CHILD',T108,           00030200
                     1'ADULT',T133,'|')                                                      00030300
0177                  WRITE(6,166)                                                           00030400
0178            166   FORMAT(1H ,T2,'|',T31,'LATENCY  PLATEAU  DEATH RATE',T64,'LATENCY'00030500
                     1,'  PLATEAU  DEATH RATE',T97,'LATENCY  PLATEAU  DEATH RATE',T133,      00030600
                     2'|')                                                                   00030700
0179                  WRITE(6,16)                                                            00030800
0180                  DO 130 CAN=1,NOCAN                                                     00030900
0181                    WRITE(6,176)(CANCER(K,CAN),K=1,3),FLTNCY,FPLATO,FDEATH,              00031000
                     1  CLTNCY(CAN),CPLATO(CAN),CDEATH(CAN),ALTNCY(CAN),APLATO(CAN),         00031100
                     2  ADEATH(CAN)                                                          00031200
0182            176     FORMAT(1H ,T2,'|',T9,3A4,T31,I5,T40,I5,T46,F10.3,T64,I5,T73,I5,      00031300
                     1  T79,F10.3,T97,I5,T108,I5,T114,F10.3,T133,'|')                        00031400
0183            130   CONTINUE                                                               00031500
0184                  WRITE(6,16)                                                            00031600
0185                  WRITE(6,6)                                                             00031700
0186                  WRITE(6,16)                                                            00031800
                C                                                                            00031900
                C     ...OUTPUT CANCER DEATHS FOR ALL STAGES                                 00032000
                C                                                                            00032100
0187                  WRITE(6,186)                                                           00032200
0188            186   FORMAT(1H ,T2,'|',T27,'CANCER',T54,'FETAL',T69,'CHILD',T84,            00032300
                     1'ADULT',T104,'TOTAL',T133,'|')                                         00032400
0189                  WRITE(6,16)                                                            00032500
0190                  GO TO(485,535,255,265),SW5                                             00032600
0191                  IF(SW5.NE.1)GO TO 255                                                  00032700
0192            535   DO 140 CAN=1,NOCAN                                                     00032800
0193                    WRITE(6,196)(CANCER(K,CAN),K=1,3)                                    00032900
0194            196     FORMAT(1H ,T2,'|',T27,3A4,T133,'|')                                  00033000
0195            140   CONTINUE                                                               00033100
0196                  WRITE(6,206) (ALLCAN(111,STG,TOTCAN),STG=1,4)                          00033200
0197            206   FORMAT(1H ,T2,'|',T27,'TOTAL',T52,F5.2,T67,F5.2,T82,F5.2,T102,         00033300
                     1F5.2,T133,'|')                                                         00033400
0198                  GO TO 245                                                              00033500
0199            255   IF(SW5.NE.2)GO TO 265                                                  00033600
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  0200               DO 150 CAN=1,NOCAN
  0201                 WRITE(6,216)(CANCER(K,CAN),K=1,3), ALLCAN(111,4,CAN)          00033700
  0202         216       FORMAT(1H ,T2,'|',T27,3A4,T102,F5.2,T133,'|')                 00033800
  0203         150   CONTINUE                                                        00033900
  0204               WRITE(6,226)ALLCAN(111,4,TOTCAN)                                00034000
  0205         226   FORMAT(1H ,T2,'|',T27,'TOTAL',T102,F5.2,T133,'|')               00034100
  0206               GO TO 245                                                       00034200
  0207         265   DO 160 CAN=1,NOCAN                                              00034300
  0208                 WRITE(6,236)(CANCER(K,CAN),K=1,3),(ALLCAN(111,I,CAN),I=1,4)   00034400
  0209         236     FORMAT(1H ,T2,'|',T27,3A4,T52,F11.5,T67,F11.5,T82,F11.5,T102, 00034500
                    1  F11.5,T133,'|')                                               00034600
  0210         160   CONTINUE                                                        00034700
  0211               WRITE(6,246)(ALLCAN(111,STG,TOTCAN),STG=1,4)                    00034800
  0212         246   FORMAT(1H ,T2,'|',T27,'TOTAL',T52,F11.5,T67,F11.5,T82,F11.5,T102, 00034900
                    1F11.5,T133,'|')                                                 00035000
  0213         245   WRITE(6,16)                                                     00035100
  0214               WRITE(6,6)                                                      00035200
  0215               WRITE(6,16)                                                     00035300
              C                                                                      00035400
              C      ...OUTPUT ADDITIONAL RISK                                       00035500
              C                                                                      00035600
  0216         485   GO TO(295,275,275,285,285),SW4                                  00035700
  0217         275   WRITE(6,256)NOARCO(111)                                         00035800
  0218         256   FORMAT(1H, T2,'|',T27,'NUMBER OF DEATHS CAUSED BY ',            00035900
                    1'NON-RADIATION RISKS',T104,F11.5,T133,'|')                      00036000
  0219               WRITE(6,16)                                                     00036100
  0220               WRITE(6,6)                                                      00036200
  0221               WRITE(6,16)                                                     00036300
  0222               GO TO 295                                                       00036400
  0223         285   WRITE(6,256)ARCO(111)                                           00036500
  0224                WRITE(6,16)                                                    00036600
  0225               WRITE(6,6)                                                      00036700
  0226               WRITE(6,16)                                                     00036800
              C                                                                      00036900
              C      ...OUTPUT TOTAL NUMBER OF INCREMENTAL DEATHS                    00037000
              C                                                                      00037100
  0227         295   WRITE(6,266)ADDEAD                                              00037200
  0228         266   FORMAT(1H ,T2,'|',T27,'TOTAL NUMBER OF INCREMENTAL DEATHS',T104, 00037300
                    1F11.5,T133,'|')                                                 00037400
  0229               WRITE(6,16)                                                     00037500
  0230               WRITE(6,6)                                                      00037600
              C                                                                      00037700
              C      ...OUTPUT GENERATED LIFE TABLE                                  00037800
              C                                                                      00037900
  0231               GO TO(345,505,515,505),SW6                                      00038000
  0232         505   CALL LTHEAD(SW1)                                                00038100
  0233               INTBLK = (STATRF + 4) / 5                                       00038200
  0234               DO 170 AGE=STATRF,110                                           00038300
                                                                                     00038400
```

```
 0235                  WRITE(6,276)(INTAGE(AGE,J),J=1,2),(GLTABL(AGE,N),N=1,9)             00038500
 0236           276    FORMAT(1H ,T2,'|',T4,I3,'-',I3,' | ',F12.10,' | ',F12.10,' | ', 00038600
                    1  F12.10,' | ',F11.4,' | ',F9.4,' | ',F10.4,' | ',F12.4,' | ',        00038700
                    2  F9.6,' | ',F8.4,T133,'|')                                           00038800
 0237                  LINE = MOD(AGE-1,5) + 1                                             00038900
 0238                  IF(LINE.EQ.5)GO TO 315                                              00039000
 0239           170  CONTINUE                                                              00039100
 0240                GO TO 325                                                             00039200
 0241           315  WRITE(6,286)                                                          00039300
 0242           286  FORMAT(1H ,T2,'|',T12,'|',T27,'|',T42,'|',T57,'|',T71,'|',T83,'|',00039400
                    1T96,'|',T111,'|',T123,'|',T133,'|')                                   00039500
 0243                NOWBLK = (AGE + 4)/5                                                  00039600
 0244                IF(NOWBLK-INTBLK.EQ.7)GO TO 335                                       00039700
 0245                GO TO 170                                                             00039800
 0246           335  CALL LTHEAD(SW1)                                                      00039900
 0247                INTBLK = NOWBLK + 1                                                   00040000
 0248                GO TO 170                                                             00040100
 0249           325  WRITE(6,6)                                                            00040200
 0250                WRITE(6,6)                                                            00040300
              C                                                                            00040400
              C      ...DETERMINE TYPE OF ADDITIONAL OUTPUT                                00040500
              C                                                                            00040600
 0251           515  GO TO(345,345,355,365,355),SW6                                        00040700
              C                                                                            00040800
              C      ...OUTPUT STAGE TABLE                                                 00040900
              C                                                                            00041000
 0252           355  CALL STHEAD                                                           00041100
 0253                STATRF = 1                                                            00041200
 0254                INTBLK = (STATRF+4) / 5                                               00041300
 0255                DO 190 AGE=STATRF,110                                                 00041400
 0256                  WRITE(6,336)(INTAGE(AGE,J),J=1,2),                                  00041500
                    1  (ALLCAN(AGE,STG,TOTCAN),STG=1,4)                                    00041600
 0257           336    FORMAT(1H ,T28,'|',T36,I3,'-',I3,T50,'|',T55,F5.2,T63,'|',T66,  00041700
                    1  F5.2,T73,'|',T77,F5.2,T86,'|',T93,F5.2,T105,'|')                    00041800
 0258                  LINE = MOD(AGE-1,5) + 1                                             00041900
 0259                IF(LINE.EQ.5) GO TO 375                                               00042000
 0260           190  CONTINUE                                                              00042100
 0261                GO TO 405                                                             00042200
 0262           375  WRITE(6,316)                                                          00042300
 0263           316  FORMAT(1H ,T28,'|',T50,'|',T63,'|',T73,'|',T86,'|',T105,'|')          00042400
 0264                NOWBLK = (AGE+4) / 5                                                  00042500
 0265                IF(NOWBLK-INTBLK.EQ.7) GO TO 395                                      00042600
 0266                GO TO 190                                                             00042700
 0267           395  CALL STHEAD                                                           00042800
 0268                INTBLK = NOWBLK + 1                                                   00042900
 0269                INTBLK = NOWBLK + 1                                                   00043000
 0270                GO TO 190                                                             00043100
 0271           405  WRITE(6,306)                                                          00043200
```

```
0272          306  FORMAT(1H ,T28,'|-------------------------------------------------',00043300
                  1'-------------------------------|')                          00043400
0273               WRITE(6,306)                                                 00043500
              C                                                                 00043600
              C      ...OUTPUT CANCER TABLE                                     00043700
              C                                                                 00043800
0274          365  IF(SW5.EQ.3)GO TO 345                                        00043900
0275          445  CALL CTHEAD(CANCER)                                          00044000
0276               STATRF = 1                                                   00044100
0277               INTBLK = (STATRF+4) / 5                                      00044200
0278               DO 200 AGE=STATRF,110                                        00044300
0279                 WRITE(6,346)(INTAGE(AGE,J),J=1,2),ALLCAN(AGE,4,TOTCAN),    00044400
                  1  (ALLCAN(AGE,4,CAN),CAN=1,NCCAN)                            00044500
0280          346    FORMAT(1H ,T2,'|',T7,I3,'-',I3,T123,'|',T125,F5.2,T133,'|',T18, 00044600
                  1  '|',T23,F5.2,T33,'|',T38,F5.2,T48,'|',T53,F5.2,T63,'|',T68,F5.2,00044700
                  2  T78,'|',T83,F5.2,T93,'|',T98,F5.2,T108,'|',T113,F5.2)      00044800
0281               LINE = MOD(AGE-1,5) + 1                                      00044900
0282               IF(LINE.EQ.5) GO TO 415                                      00045000
0283          200  CONTINUE                                                     00045100
0284               GO TO 425                                                    00045200
0285          415  WRITE(6,366)                                                 00045300
0286          366  FORMAT(1H ,T2,'|',T18,'|',T33,'|',T48,'|',T63,'|',T78,'|',T93,'|',00045400
                  1T108,'|',T123,'|',T133,'|')                                  00045500
0287               NOWBLK = (AGE+4) / 5                                         00045600
0288               IF(NOWBLK - INTBLK.EQ.7) GO TO 435                           00045700
0289               GO TO 200                                                    00045800
0290          435  CALL CTHEAD(CANCER)                                          00045900
0291               INTBLK = NOWBLK + 1                                          00046000
0292               GO TO 200                                                    00046100
0293          425  WRITE(6,366)                                                 00046200
0294               WRITE(6,6)                                                   00046300
0295               WRITE(6,366)                                                 00046400
0296               WRITE(6,356)ALLCAN(111,4,TOTCAN),(ALLCAN(111,4,I),I=1,NOCAN) 00046500
0297          356  FORMAT(1H ,T2,'|',T7,'TOTAL',T125,F7.2,T133,'|',T18,'|',T23,F6.2, 00046600
                  1T33,'|',T38,F6.2,T48,'|',T53,F6.2,T63,'|',T68,F6.2,T78,'|',T83,   00046700
                  2F6.2,T93,'|',T98,F6.2,T108,'|',T113,F6.2,T123,'|')           00046800
0298               WRITE(6,366)                                                 00046900
0299               WRITE(6,6)                                                   00047000
0300               WRITE(6,6)                                                   00047100
              C                                                                 00047200
              C      ...INTIALIZE MATRICES FOR NEXT CASE                        00047300
              C                                                                 00047400
0301          345  CONTINUE                                                     00047500
0302               DO 210 AGE=1,111                                             00047600
0303                 TDEAD(AGE) = 0.0                                           00047700
0304                 ARCO(AGE) = 0.0                                            00047800
0305                 NOARCO(AGE) = 0.0                                          00047900
0306                 DO 220  N=1,9                                              00048000
```

```
 0307                         GLTABL(AGE,N) = 0.0                                     00048100
 0308                         DO 230   STG=1,4                                        00048200
 0309                           ALLCAN(AGE,STG,N) = 0.0                               00048300
 0310               230       CONTINUE                                                00048400
 0311               220     CONTINUE                                                  00048500
 0312               210   CONTINUE                                                    00048600
 0313                     IF(CASREP.EQ.1)GO TO 5                                      00048700
 0314                     GO TO 35                                                    00048800
 0315                15   STOP                                                        00048900
 0316                     END                                                         00049000
```

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                 C                                                                          00049100
                 C      ***   NON-RADIATION RISK SUBROUTINE   ***                           00049200
                 C                                                                          00049300
 0001                   SUBROUTINE ACCRSK(SW4,BEGAGE,ENDAGE,CASREP,ADDRSK)                  00049400
 0002                   REAL*8 ADDRSK(1),SINRSK                                             00049500
 0003                   INTEGER SW4,AGE,BEGAGE,ENDAGE,CASREP                                00049600
 0004                   GO TO(5,15,25,15,25),SW4                                            00049700
 0005              15   READ(5,7)CASREP,SINRSK                                              00049800
 0006               7   FORMAT(I5,F10.9)                                                    00049900
 0007                   DO 10 AGE=BEGAGE,ENDAGE                                             00050000
 0008                     ADDRSK(AGE) = SINRSK                                              00050100
 0009              10   CONTINUE                                                            00050200
 0010                   GO TO 5                                                             00050300
 0011              25   READ(5,17)CASREP,(ADDRSK(AGE),AGE=1,110)                            00050400
 0012              17   FORMAT(I5/14(8F10.9/))                                              00050500
 0013               5   RETURN                                                              00050600
 0014                   END                                                                 00050700
```

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                  C                                                                    000508C0
                  C      ***   FETAL RADIATION RISK SUBROUTINE   ***                   00050900
                  C                                                                    00051000
 0001                    SUBROUTINE FETRSK(SW3,FLTNCY,FPLATO,DOSE,DEATHS,IXR)          00051100
 0002                    REAL*8 IXR(1),DEATHS,DOSE                                     00051200
 0003                    INTEGER SW3,START,END,FLTNCY,FPLATO                           00051300
 0004                    IF(SW3.EQ.3)GO TO 5                                           00051400
 0005                    RISK = DOSE * (DEATHS/1000000.0)                              00051500
 0006                    GO TO 15                                                      00051600
 0007               5    RISK = DOSE * DEATHS                                          00051700
 0008              15    START = FLTNCY + 1                                            00051800
 0009                    END = FLTNCY + FPLATO                                         00051900
 0010                    DO 10 I=START,END                                             00052000
 0011                    IXR(I) = RISK                                                 00052100
 0012              10    CONTINUE                                                      00052200
 0013                    RETURN                                                        00052300
 0014                    END                                                           00052400
```

```
      C
      C     ***   CHILD & ADULT RADIATION RISK SUBROUTINE   ***
      C
            SUBROUTINE CARSK(SW3,BEGAGE,YRSEXP,DOSE,LATNCY,PLATOE,DEATHS,IXR)
            REAL*8 IXR(1)
            INTEGER BEGAGE,YRSEXP,PLATOE,SW3,YR,AGE,BEGHLF,STRTAG,ENDAG
            GO TO (5,5,15),SW3
          5 RISK = DOSE * (DEATHS/1000000.0)
            GO TO 25
         15 RISK = DOSE * DEATHS
         25 BEGHLF = BEGAGE + LATNCY + 1
            DO 10 YR=1,YRSEXP
              IXR(BEGHLF) = IXR(BEGHLF) + 0.5 * RISK
              STRTAG = BEGHLF + 1
              ENDAG  = BEGHLF + PLATOE - 1
              IF(ENDAG.LE.110)GO TO 35
              IF(ENDAG-PLATOE.GE.110)GO TO 45
              ENDAG = 110
         35   DO 20 AGE=STRTAG,ENDAG
                IXR(AGE) = IXR(AGE) + RISK
         20   CONTINUE
              BEGHLF = BEGHLF + 1
              IF(ENDAG.EQ.110)GO TO 10
              IXR(ENDAG+1) = IXR(ENDAG+1) + 0.5 * RISK
         10 CONTINUE
         45 DO 30 AGE=1,110
              IXR(111) = IXR(111) + IXR(AGE)
         30 CONTINUE
            RETURN
            END
```

```
C
C     *** LIFE TABLE HEADING SUBROUTINE    ***
C
      SUBROUTINE LTHEAD(SW1)
      INTEGER SW1
      WRITE(6,63)
   63 FORMAT(1H1,' ')
      WRITE(6,61)
      IF(SW1.EQ.1) GO TO 125
      IF(SW1.EQ.2) GO TO 135
      WRITE(6,83)
   83 FORMAT(' ',T2,'|',T27,'GENERATED LIFE TABLE FOR THE GENERAL',
     1' POPULATION: UNITED STATES, 1969-71',T133,'|')
      GO TO 145
  125 WRITE(6,60)
   60 FORMAT(' ',T2,'|',T36,'GENERATED LIFE TABLE FOR MALES: UNITED ',
     1'STATES 1969-71',T133,'|')
      GO TO 145
  135 WRITE(6,84)
   84 FORMAT(' ',T2,'|',T35,'GENERATED LIFE TABLE FOR FEMALES: UNITED',
     1' STATES 1969-71',T133,'|')
  145 WRITE(6,61)
   61 FORMAT(' ',T2,'|-------------------------------------------------------',
     1'--------------------------------------------------------------',
     2'--------------------------|')
      WRITE(6,62)
   62 FORMAT(1H ,T2,'|',T12,'|',T27,'|',T42,'|',T57,'|',T71,'|',T83,
     1'|',T96,'|',T111,'|',T123,'|',T133,'|')
      WRITE(6,70)
   70 FORMAT(1H ,T2,'|',T3,'X TO X+T I',T18,'TQX',T27,'|',T33,'IXR',
     1T42,'|',T48,'TQXR',T57,'|',T63,'LXR',T71,'|',T76,'DXR',T83,'|',
     2T88,'TLXR',T96,'|',T102,'TXR',T111,'|',T116,'EXR',T123,'|',T126,
     3'IXRLXR',T133,'|')
      WRITE(6,62)
      WRITE(6,61)
      WRITE(6,62)
      WRITE(6,71)
   71 FORMAT(1H ,T2,'|',T4,'YEARS',T12,'|',T27,'|',T42,'|',T57,'|',T71,
     1'|',T83,'|',T96,'|',T111,'|',T123,'|',T133,'|')
      WRITE(6,62)
      RETURN
      END
```

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                  C                                                                              00059800
                  C      ***   STAGE TABLE HEADING SUBROUTINE   ***                              00059900
                  C                                                                              00060000
 0001                    SUBROUTINE STHEAD                                                       00060100
 0002                    WRITE(6,6)                                                              00060200
 0003                  6 FORMAT(1H1,' ')                                                         00060300
 0004                    WRITE(6,16)                                                             00060400
 0005                 16 FORMAT(1H ,T28,'|-----------------------------------------------',00060500
                        1'-----------------------------|')                                       00060600
 0006                    WRITE(6,26)                                                             00060700
 0007                 26 FORMAT(1H ,T28,'|',T33,'AGE DISTRIBUTION OF RADIATION ',                00060800
                        1' DEATHS BY STAGE FOR ALL CANCERS COMBINED',T105,'|')                   00060900
 0008                    WRITE(6,16)                                                             00061000
 0009                    WRITE(6,36)                                                             00061100
 0010                 36 FORMAT(1H ,T28,'|',T50,'|',T63,'|',T73,'|',T86,'|',T105,'|')            00061200
 0011                    WRITE(6,46)                                                             00061300
 0012                 46 FORMAT(1H ,T28,'|',T38,'AGES',T50,'|',T55,'FETAL',T63,'|',T66,          00061400
                        1'CHILD',T73,'|',T77,'ADULT',T86,'|',T93,'TOTAL',T105,'|')               00061500
 0013                    WRITE(6,36)                                                             00061600
 0014                    WRITE(6,16)                                                             00061700
 0015                    WRITE(6,36)                                                             00061800
 0016                    RETURN                                                                  00061900
 0017                    END                                                                     00062000
```

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FORTRAN IV G1  RELEASE 2.0              MAIN               DATE = 78193          13/44/22            PAGE 0001
        C                                                                       00062100
        C     ***   CANCER TABLE HEADING SUBROUTINE   ***                       00062200
        C                                                                       00062300
0001          SUBROUTINE CTHEAD(CANCER)                                         00062400
0002          REAL*4 CANCER(3,10)                                               00062500
0003          INTEGER CAN                                                       00062510
0004          WRITE(6,6)                                                        00062600
0005        6 FORMAT(1H1,' ')                                                   00062700
0006          WRITE(6,16)                                                       00062800
0007       16 FORMAT(1H ,T2,'|------------------------------------------------',00062900
             1'---------------------------------------------------------------',00063000
             2'-------------------|')                                           00063100
0008          WRITE(6,26)                                                       00063200
0009       26 FORMAT(1H ,T2,' ',T37,'AGE DISTRIBUTION OF RADIATION',            00063300
             1' DEATHS BY CANCER TYPE FOR ALL STAGES COMBINED',T133,' ')        00063400
0010          WRITE(6,16)                                                       00063500
0011          WRITE(6,36)                                                       00063600
0012       36 FORMAT(1H ,T2,'|',T18,'|',T33,'|',T48,'|',T63,'|',T78,'|',T93,'|',00063700
             1T108,'|',T123,'|',T133,'|')                                       00063800
0013          WRITE(6,46)((CANCER(K,CAN),K=1,3),CAN=1,7)                        00063900
0014       46 FORMAT(1H ,T2,'|',T9,'AGES',T18,'|',T33,'|',T48,'|',T63,'|',T78,  00064000
             1'|',T93,'|',T108,'|',T123,'|',T126,'TOTAL',T133,'|',T20,3A4,T35,  00064100
             23A4,T50,3A4,T65,3A4,T80,3A4,T95,3A4,T110,3A4)                     00064200
0015          WRITE(6,36)                                                       00064300
0016          WRITE(6,16)                                                       00064400
0017          WRITE(6,36)                                                       00064500
0018          RETURN                                                            00064600
0019          END                                                               00064700
```

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